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ASTM BULLETIN

MAY 1953
Number 190

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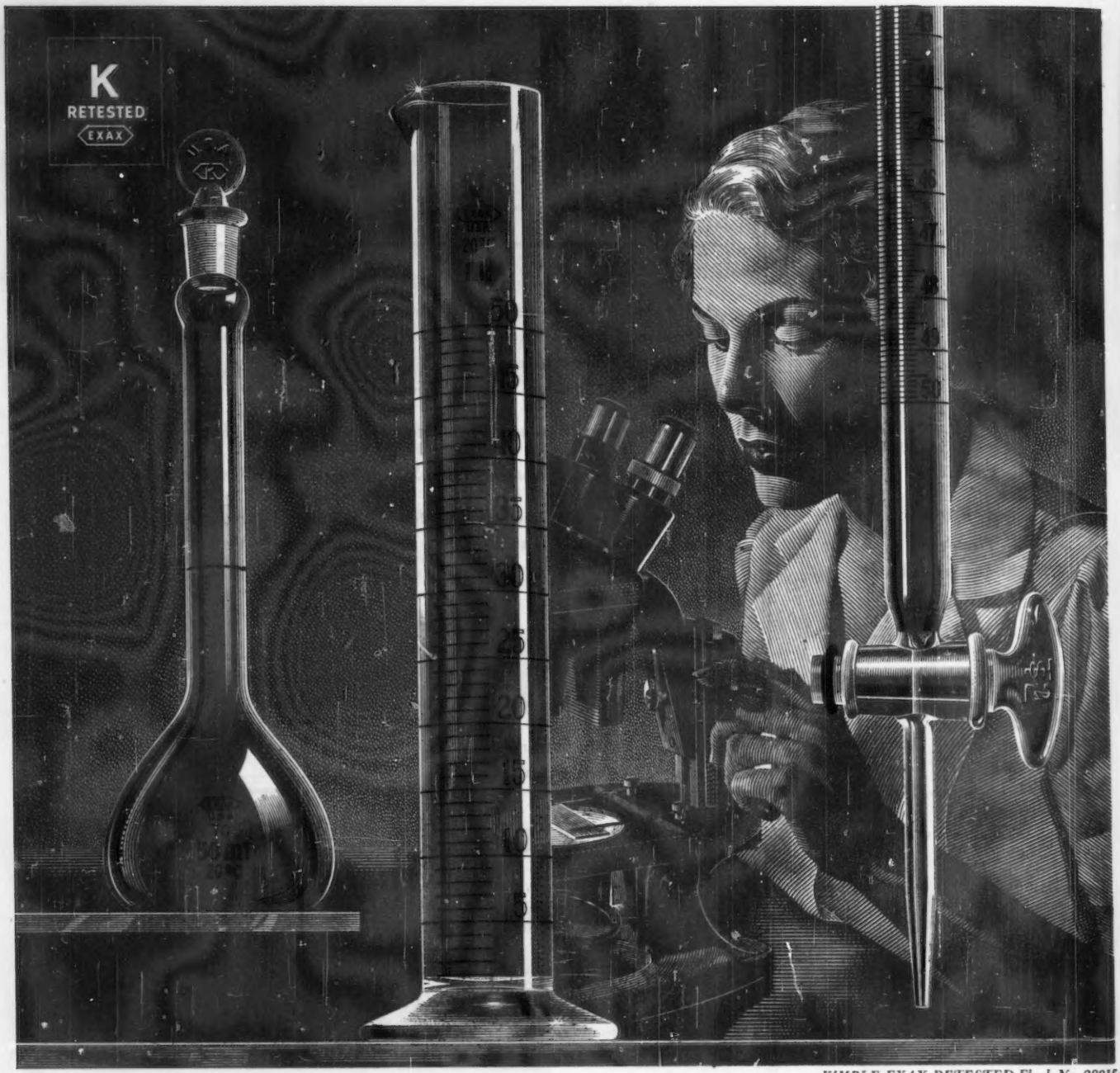

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ASTM BULLETIN

"Promotion of Knowledge of Materials of Engineering, and Standardization of Specifications and Methods of Testing"

Number 190 MAY, 1953

56th Annual Meeting Presents Big and Varied Technical Program

Thirty-four Sessions Include Seven Symposiums, Hundreds of Committee Meetings, and Special Features Arranged for Atlantic City Gathering

THIRTY-FOUR sessions and scores of committee and subcommittee meetings will be packed into the schedule of the 56th Annual Meeting of the Society at Chalfonte-Haddon Hall in Atlantic City, June 28 to July 3. These sessions include seven symposiums, the Gillett and Marburg lectures on metallurgy and petroleum, respectively; the President's Luncheon; and the social highlight, the cocktail party and annual dinner.

The complete Provisional Program of this big meeting appears on pages 7 to 24. It includes dates and hours of each session and abstracts of papers.

Technical Program

A clear picture of the nature and content of the symposiums can be obtained from the introductions and abstracts of the individual papers which appear in the Provisional Program. Titles of the symposiums, which cover a wide range of technical interests, are as follows:

Metallic Materials at Low Temperatures
X-Ray Spectrographic Analysis
Radioactivity in ASTM Work
Electron Metallography
Lateral Pile Load Tests
Porcelain Enamel
Soil Dynamics

In addition to these symposiums, there are also sessions on Steel, Fatigue, Methods of Atmospheric Sampling and Analysis, Concrete, Plastics, Significance of Tests of Concrete, and Corrosion.

Marburg Lecture

Frederick D. Rossini, Silliman Professor and Head of the Department of Chemistry and Director of the American Petroleum Institute Research Laboratory at the Carnegie Institute of Technology, will present the 27th Edgar Marburg Lecture titled "An Excursion in Petroleum Chemistry," Wednesday afternoon, July 1.

This lecture originated as a memorial to the first Secretary of the Society and was established to emphasize the importance of furthering knowledge of properties and tests of engineering materials.

Dr. Rossini will describe outstanding developments in our knowledge of petroleum and will outline the interesting story of fundamental research in petroleum chemistry as performed in the laboratories of petroleum companies. He will discuss projects supported cooperatively by the petroleum industry through the American Petroleum Institute, and in particular will review API Research Projects covering the composition of crude petroleum and the researches conducted to make available to the laboratories of the petroleum industry and to the technical world all of the known data on hydrocarbons and related compounds. This extensive laboratory work also involved searching the entire scientific literature, appraising and arranging data in a useful form, and distributing these data both on a national and international scale.

Provisional Program

The Provisional Program of the 56th Annual Meeting, outlined on page 7, is designed to give members a comprehensive picture of the sessions, symposiums, and special events of the meeting. Brief abstracts of the papers are provided as well as general statements of the scopes of some of the symposiums.

The official Program which members and guests will receive when they register will contain full and final details of the sessions, a complete schedule of committee meetings, and the when and where of the entertainment features of the week.

Gillett Lecture

Jerome Strauss, Vice-President, Vanadium Corp. of America, New York, will present the second H. W. Gillett Memorial Lecture on the subject "Micrometallurgy," Tuesday afternoon, June 30.

This lecture—first presented at the Fiftieth Anniversary Meeting of the ASTM in 1952—is jointly sponsored by the American Society for Testing Materials and Battelle Memorial Institute and commemorates Horace W. Gillett, the first Director of Battelle, and one of America's leading technologists and metallurgists. Its scope covers subjects pertaining to the development, testing, evaluation, and application of metals.

Mr. Strauss' lecture will involve the significance and effect of very small and in some cases minute quantities of elements on various metals and alloys. Fractions of a per cent of some elements have an important bearing on the use of alloys—frequently beneficial, occasionally deleterious. Small amounts of boron in steel, for example, have important effects in improving the heat-treating properties. Nitrogen and other elements influence the properties. Mr. Strauss will cover many other similar situations.

Committee Meetings

Necessity of making late decisions and arrangements affecting committee meetings renders it impossible to send out an advance detailed schedule. Published lists are tentative and members should

The Marburg Lecturer . . .

Frederick D. Rossini, *Silliman Professor and Head of the Chemistry Department and Director of the American Petroleum Research Laboratory at Carnegie Tech., has achieved renown as an authority in the field of physical chemistry. While at the National Bureau of Standards he did outstanding research in the fundamental composition of petroleum and, hydrocarbons. He has a broad background as an educator, lecturer, scientist, and author, and years of service as a leading member of ASTM Committee D-2 on Petroleum Products. Dr. Rossini has a deep personal interest in teaching and has lectured at leading universities throughout the country. In 1946, he was elected President of the Commission on Thermochemistry of the International Union of Pure and Applied Chemistry, having been nominated in 1934 as the United States member of the Commission. He is the author or co-author of approximately 150 scientific papers dealing with thermochemistry and hydrocarbons.*

rely on official notification from their committee and subcommittee officers for authoritative information. Final details of technical committee schedules are usually not available until early in June.

President's Luncheon

The President's Luncheon, an always popular annual meeting event, which will be held Tuesday noon, June 30, is not a technical session and contains neither papers nor Society business. It features the address of retiring President Harold L. Maxwell; award of honorary memberships to individuals of widely acknowledged eminence in the fields of work covered by the Society, or who have rendered especially meritorious service to the Society; Awards of Merit to men who have rendered distinguished service to the Society along technical lines; recognition of 50 and 40-year members; and introduction of incoming officers.

Hotel Reservations

The publication of the Provisional Program should assist those who have not yet made their hotel reservations in determining the dates of their attendance at the Annual Meeting. Reservations should be made as promptly as possible. The headquarters hotel is Chalfonte-Haddon Hall but rooms for single occupancy will be severely restricted there in order that the largest number of members can stay at headquarters.

Management of Chalfonte-Haddon Hall have advised us that they will extend the convention rates to members over the Fourth of July week end which follows the close of the meeting.

Cooperating hotels in which enough rooms have been blocked off to accommodate all who will attend, are the Claridge, Colton Manor, Morton, Lafayette, Seaside, and Senator.

Hotel reservation forms were sent to members in April. If you have not received yours write Headquarters as soon as possible.

Preprints of Papers and Reports

Each member has received a Preprint Request Blank which he should mark and return to ASTM Headquarters indicating the papers and reports he would like to have in advance of the meeting. It should be borne in mind that *all* papers are *not* preprinted, but the material, which is mailed out in three installments, gives a good picture of the content of the sessions and provides material on which prepared discussions can be based.

Entertainment Features

The entertainment features for the meeting, including events for the ladies, are being sponsored by the Philadelphia District which augurs well for these events since the Philadelphia group has arranged features at earlier meetings that have met with approval.

A high point of the entertainment will be the annual informal dinner with entertainment and dancing on Wednesday evening, July 1. A "Dutch" cocktail-social hour will precede this. Reservations for dinner and all events may be made in advance through a form which is part of a Circular to Members dated May 31.

The ladies' entertainment will include: Tea and Musicale (Monday afternoon); Sight-seeing Boat Trip (Tuesday morning); ASTM Luncheon (Tuesday noon); Special Book Review (Tuesday evening); ASTM Dinner (Wednesday evening); and a Ladies' Luncheon with hat-making demonstration (Thursday noon), with another feature possible for Thursday evening. Rolling Chair tickets will be available on request.

Direct Pullman Accommodations to Atlantic City

Direct Pullman Service to Atlantic City will be available if a sufficient number of ASTM members from an intermediate area or route desire such service. Most railway companies will make the necessary arrangements, and those interested should contact their local ticket office.

The Gillett Lecturer . . .

Jerome Strauss, *Vice-President, Vanadium Corp. of America, has had wide experience in the alloy metals field, serving in capacities as chief chemist and metallurgist, materials engineer, and chief research engineer. He has been Chairman of ASTM Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys since its organization in 1929, and serves on many other technical committees. He represents ASTM on the Iron Alloys Research Committee of the Engineering Foundation. In 1940 he was elected a member of the Board of Directors of the American Standards Association, and from 1940 to 1942 served as a Member of the Executive Committee of the American Society for Testing Materials. His career has qualified him admirably to present a lecture in keeping with Dr. Gillett's broad interest—the critical evaluation of metals and alloys. He is the author of numerous papers, reports, and articles in the metallurgical field.*

This Program is Subject to Change

All time indicated is Eastern Daylight Saving Time

Provisional Program

FIFTY-SIXTH ANNUAL MEETING

of the

AMERICAN SOCIETY FOR TESTING MATERIALS

ATLANTIC CITY, N. J. **JUNE 28 TO JULY 3, 1953**

Committee Meetings held throughout the week at Chalfonte-Haddon Hall

	SUNDAY, June 28	MONDAY, June 29	TUESDAY, June 30	WEDNESDAY, July 1	THURSDAY, July 2	FRIDAY, July 3
Morning		*2nd* Symposium on Low Temperatures (*cont.*) (Report Jt. Effect Temperature)	*6th* Symposium on Low Temperatures (*cont.*) *7th* Symposium on Radioactivity in ASTM Work	*19th* Session on Methods of Atmospheric Sampling and Analysis (Report D-22) *20th* Symposium on Lateral Pile Load Tests *21st* Session on Fatigue (*cont.*)	*26th* Symposium on Porcelain Enamel (Report C-22)	*32nd* Session on Steel (Report A-1)
11:30 a.m.			*8th* Report Session—(Reports D-3, D-5, D-7, D-10, D-21, D-22, D-23) *9th* Report Session—(Reports B-1, B-4, B-5, B-8, B-9, C-3, C-4)	*22nd* Report Session—(Reports D-16, D-19, E-8, E-11, E-12, E-13, E-14)		*33rd* Report Session—(Reports D-2, D-4, D-11, D-12 D-13, D-14, D-15, D-17, D-18) *34th* Report Session—(Reports C-1, C-2, C-8, C-15, C-16, C-17, C-18, C-19, C-20, C-21, E-5, E-6)
Noon			*10th* Luncheon Session President's Address, Award of Honorary Memberships, 40- and 50-Year Memberships, Award of Merit, Introduction of New Officers			
Afternoon		*3rd* Symposium on Low Temperatures (*cont.*) *4th* Symposium on X-Ray Spectrographic Analysis (Report E-2 E-3)	*11th* Report Session—(Reports A-2, A-3, A-6, A-7, B-2) *12th* Symposium on Radioactivity (*cont.*) *13th* Symposium on Electron Metallography *14th* Session on Steel 4:30 p.m. *15th* Gillett Lecture—Micrometallurgy—Jerome Strauss	*23rd* Symposium on Lateral Pile Load Tests (*cont.*) *24th* Session on Concrete (Reports C-7, C-9, C-11, C-12, D-1, D-6, D-8) 4:30 p.m. *25th* Marburg Lecture—An Excursion in Petroleum Chemistry — Frederick D. Rossini. Medal Awards	—1:30 p.m.— *27th* Plastics (Reports D-9, D-20) —2:30 p.m.— *28th* Symposium on Porcelain Enamel (*cont.*) *29th* Symposium on Soil Dynamics	
Evening	*1st* Symposium on Metallic Materials at Low Temperatures	*5th* Symposium on Low Temperatures (*cont.*)	*16th* Session on Fatigue (Report E-9) *17th* Symposium on Electron Metallography (Report E-4) *18th* Significance of Tests of Concrete	Cocktail Party and Annual Dinner Entertainment	*30th* Symposium on Soil Dynamics (*cont.*) *31st* Corrosion (Reports A-5, A-9, A-10, B-3, B-6, B-7, E-1, E-7)	

ASTM Registration Desk opens Sunday afternoon, June 28.

Sunday, June 28 8:00 p.m. First Session

Symposium on Metallic Materials at Low Temperatures

Introduction. A. L. Tarr, U. S. Department of the Army, Corps of Engineers.

Despite the existence of a large accumulation of data, technical papers, and reports on the low-temperature properties and behavior of metallic materials, sudden, unexpected, and frequently disastrous failures continue to occur in engineering structures and expensive equipment. Very little of the wealth of available information has been fully evaluated and found its way into the commonly used handbooks. Furthermore, it is apparent that there is a lack of general comprehension and application of the knowledge which has been reported by investigators concerning important metallurgical and mechanical variables and their influence on low-temperature ductility and the mechanism of fracture.

Consequently, the Low Temperature Panel of the ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals is now sponsoring a Symposium on Metallic Materials at Low Temperatures to bring together and summarize the state of knowledge of the subject, up to the present, in an effort to make designers and materials engineers more fully cognizant of the joint role played by metallurgical and mechanical factors in their influence on the behavior of metals at low temperatures, and particularly of the variable response to variations in stress systems, strain rates, and size effects.

In this symposium, the treatment of structural carbon steel receives more attention than other metallic materials because of its extensive application and consequently great importance in engineering structures. The first three papers, which result from the extensive and well-directed studies of ship steel and ship structures, provide a sound foundation for the entire program. However, the five sessions of the symposium, devoted as they are to (1) the evaluation of brittle failures in ships and engineering structures, (2) criteria of metal behavior for design engineers, (3) metallurgical and mechanical factors, (4) significance and reliability of notch toughness tests, and (5) certain aspects of current research, including new data on titanium, quenched and tempered steels at high strength levels, and several types of cast irons, provide a broad coverage which should go a long way toward eliminating many misconceptions regarding the function and suitability of laboratory and simulated service tests, and also give design engineers a new approach to design criteria.

It is recognized that in the time which is available it will not be possible to present a complete evaluation and correlation of all recent research and no attempt is made to do this or to present an exhaustive review of existing data on low-temperature properties of engineering metals. However, it is believed that the symposium program provides for one of the most comprehensive and authoritative presentations of this complex but very timely subject.

Having in mind the rapidly increasing interest of both civilian and military engineers in materials and design for low-temperature service, it is anticipated that the over-all attendance will be very large. It is hoped that this will lead to extensive discussions of the papers and further contributions of valuable information. It is further hoped that the symposium will help to improve industrial practices in the selection of materials and designs for low-temperature service and guide the Low Temperature Panel in its mission of collecting information on present industrial practices and testing procedures and making it available to engineers.

Brittle Failure in Ships and Other Steel Structures. K. K. Cowart, U. S. Coast Guard.

Steel is generally regarded as a ductile material. However, we are learning more and more about its brittle characteristics at reduced temperatures. Considerable information is available concerning the widespread extent of brittle failures in steel. Although much publicity has been given to brittle fractures in ships, there are many examples of serious brittle fractures in steel structures other than ships.

In seeking a better understanding of the brittle characteristics of steel, it is essential that we avail ourselves of knowledge available and techniques in use in other fields of engineering and science. The Ship Structure Committee, which is exerting considerable effort toward broadening the knowledge of the brittle characteristics of steel, has turned to several other fields of engineering and science in pursuing this objective.

Analysis of Brittle Behavior in Ship Plates. M. L. Williams, National Bureau of Standards.

The factors which contributed to structural failures of welded ships are briefly discussed and illustrated. The failures are analyzed on the basis of examinations of the starting points of the fractures, results of laboratory tests of the fractured plates, and information regarding the nature and circumstances of the failures and the structural features of the ships involved. The paper emphasizes correlations or lack of correlation between service experience and the results of the various laboratory examinations and tests, and correlations between the properties that are found to be significant and the chemical compositions of the steels.

A Critical Survey of Brittle Fracture of Carbon Plate Steel Structures Other Than Ships. M. E. Shank, Massachusetts Institute of Technology.

While the failure of ships, during and since World War II, brought to the fore the problem of brittle fracture in steel plate, no comprehensive survey has ever been made of such failures in non-ship structures.

This paper undertakes to trace the history of brittle failure, from the first occurrence (in the era of riveted construction) through the present day. Evidence is shown to indicate that in many respects, riveted and welded structures have much in common so far as brittle behavior is concerned. A critical assessment is made of the present state of the problem in regard to non-ship, carbon-steel-plate structures. The effects of residual stress, steel composition and treatment, strain rate, and other factors are considered.

(Continued in Second, Third, Fifth, and Sixth Sessions)

Monday, June 29 9:00 a.m. Second Session

Symposium on Metallic Materials at Low Temperatures *(Continued)*

Interest of the Army in Brittle Failures. T. T. Paul, Watertown Arsenal.

The history of the Ordnance Corps' constant engineering, design, and metallurgical effort over a span of years to prevent brittle failure in service while developing and maintaining the ever-changing equipment needed for defense purposes is presented. The highlights of this program, that is ever-mindful of the conservation of critical alloys, the requirement that the components must be mass produced, and the fact that the items must be fully serviceable under adverse global conditions, are submitted.

Theory of Brittle Fracture and Criteria for Behavior at Low Temperatures. E. R. Parker, University of California.

This paper summarizes the effects of various factors known to contribute to the brittle behavior of steel. Standard unnotched tension specimens fail by shear at normal temperatures, but fracture by cleavage without measurable elongation at liquid nitrogen temperature. Notches reduce the ratio of maximum shear to maximum tensile stress so that brittle fractures can occur even at room temperature. The detailed action of the notch is discussed in a qualitative way. Welding tends to provide crack starters because of weld defects such as inclusions, cracks, and incomplete penetration. Chemical factors are also involved in both weld metal and base plate. Various tests for determining relative brittleness of steel are compared. A brief discussion of service failures is given and the correlation between laboratory tests and service failures is presented.

Brittle Fracture: Significance for Engineers. S. L. Hoyt, Battelle Memorial Institute.

This paper discusses the conditions for brittle fracture in terms of steel properties and defines the temperature at which it occurs in terms of stress field and strain rate. The transition temperature is discussed, and it is pointed out that it is only indirectly related to service fractures because the transition temperature of brittle fracture is usually different from that of the service failure. There follows a discussion of the principle of matching the service failure with the test bar geometry which produces brittle fracture at the service temperature. This principle appears to be sounder in theory and, in use, should be cheaper since testing over a range of temperatures would be avoided.

Report of Joint Committee on Effect of Temperature on the Properties of Metals. Francis B. Foley, Chairman.

History of Joint Committee. N. L. Mochel, Westinghouse Electric Corp.

(Continued in Third, Fifth, and Sixth Sessions)

Monday, June 29 2:00 p.m. Third Session

Held simultaneously with the Fourth Session

Symposium on Metallic Materials at Low Temperatures *(Continued)*

Metallurgical Aspects of Low-Temperature Behavior in Ferrous Materials. C. H. Lorig, Battelle Memorial Institute

The paper reviews the metallurgical factors affecting the behavior of ferrous materials at low temperatures. For the most part, steels become stronger and harder with decreasing temperature, but the important aspect of low-temperature behavior is that certain austenitic steels remain ductile and tough while other austenitic steels and all ferritic steels become brittle-sensitive at low temperatures. The behavior of the brittle-sensitive steels at low temperatures is closely related to composition, alloy content, microstructure, and heat treatment. Advantage of the influence of these factors may be taken in developing greater resistance of steels to embrittlement at low temperatures. The influence of these metallurgical factors is dealt with in some detail.

Fundamentals of Fracture in Metals. M. Gensamer, Columbia University.

The role of ductility in safeguarding structures; the nature of ductile and brittle fractures, cleavage and shear fractures, fibrous and crystalline fractures; the role of slip and twinning in fracturing; the transition from ductile to brittle behavior; the role of the normal-stress, shear-stress ratio; the critical normal stress for cleavage, the critical shear stress for flow, and their temperature dependence; transition temperature, speed, size, and shape; the correlation of transition temperatures among various testing methods, and with service; the Griffith concept and its limitations as applied to structures; the effectiveness of cracks.

The Effect of Size Upon Fracturing. G. R. Irwin, Naval Research Laboratory.

Outstanding fracture-size effects in ductile and brittle materials are illustrated and discussed. The primary causes are shown to be the tendency for fracture propagation work to approach proportionality to severed area and the distribution of local flaws. Although these two causes are associated with ductile and brittle fracturing, respectively, the distinction is not sharp. Examples and calculations are shown of the effect of size upon instability relations governing onset of uncontrolled rapid fracturing. It is apparent that new kinds of measurements as well as new systems of calculation are necessary to describe the possibilities of brittle fracturing of a structural member.

Brittleness, Triaxiality, and Localization. W. P. Roop, Anchorage Farm.

The effect of cold on notched bars has been studied by compensating it with shifts in notch acuity. The appeal to triaxiality in this connection requires explaining how moderate triaxiality can cause a high degree of brittleness.

In notched plates intension the concept of localization of strain is more useful than that of triaxiality of stress. Data are offered to show that the degree of localization notably increases with relative width of the plate.

This concept may lead to an analysis of cold brittleness in terms of relations between the strain field and advance of the incipient crack.

Effect of Metallurgical Structure on the Impact Properties of Steels. J. A. Rinebolt, Naval Research Laboratory.

A comparison of three types of microstructures on Charpy V-notch properties was made. The types of microstructures studied were normalized and spheroidized from pearlite and from martensite. Five series of steels were used in this investigation with carbon varied in the first series, manganese in the second, silicon in the third, phosphorus in the fourth, and nickel in the fifth series.

The spheroidized from martensite structure had the lowest transition temperature and highest maximum energy value of the three microstructures. The spheroidized from pearlite structure had the highest transition temperature. The normalized structure had a transition temperature between the other two structures and had the lowest maximum energy value. The transition temperature in Charpy V-notch tests was raised by carbon, phosphorus, and silicon and lowered by manganese and nickel. These effects were the same for the three types of microstructures studied.

(Continued in Fifth and Sixth Sessions)

Monday, June 29 2:00 p.m. Fourth Session

Held simultaneously with the Third Session

Symposium on Fluorescent X-Ray Spectrographic Analysis

Introduction. E. B. Ashcraft, Westinghouse Electric Corp.

Whenever primary X-rays of sufficiently short wave length are absorbed by matter the characteristic fluorescent X-rays of the elements in the specimen are excited. In recent years improvements in the generation of high intensity X-ray beams and in the means of detecting and measuring X-rays have made this principle feasible as the basis for a method of quantitative analysis. Its practical value has been attested by numerous papers within the past five years. Because of the usefulness and newness of the method and because it falls within the scope of the activities of Committee E-2 on Emission Spectroscopy, it was thought to be particularly appropriate to sponsor a symposium at this time.

Basic Theory and Fundamentals of Fluorescent X-Ray Spectrographic Analysis. Herbert Friedman, La Verne S. Birks, and Edward J. Brooks, U. S. Naval Research Laboratory.

X-ray spectrographs operated in air provide rapid, non-destructive chemical analyses of elements above atomic number 22. Evacuated spectrographs can extend the range to lower atomic numbers. Wavelength identification may be accomplished with plane or focusing crystal analyzers, with quantum energy discriminators such as the proportional and scintillation counters, or with selective filters. X-ray analyses are particularly useful for major constituents in solid or liquid specimens. Under optimum conditions analyses of parts per million are also possible.

General Aspects of Analytical Applications. J. Sherman, Philadelphia Naval Shipyard.

This paper discusses the problems involved in the correlation of X-ray fluorescent intensities and chemical composition of the sample. Following a general comparison of X-ray and optical spectrographic methods the following factors are considered: (1) the spectrum of the incident beam, (2) the effect of other elements in the sample on the intensity of the fluorescent beam of the element under consideration, (3) particle size, (4) thickness of sample, and (5) computation.

Theoretical relations are derived from the analysis of absorption effects and simplified for an adequately precise application. Typical experimental results are given to illustrate the methods and their precision.

Applications of X-Ray Fluorescence to Alloy Analysis. R. M. Brissey, H. A. Liebhafsky, and H. G. Pfeiffer, General Electric Co.

As modern alloys increase in complexity, their analysis by conventional methods grows more difficult and time consuming so that the need for adequate physical methods of analysis becomes more urgent. The most promising physical method now on the horizon is that of X-ray fluorescence. Fortunately, the elements in the range of atomic numbers easily accessible to the method include most of the metals important as constituents of the newer alloys.

The literature on the analysis of metals and alloys by X-ray fluorescence methods will be reviewed with emphasis on self-absorption and the need for high resolution, two features especially important in this field. Castaing's adaptation of an electron microscope for the point-to-point exploration of alloy surfaces will also be described.

The Fluorescent X-Ray Spectrographic Analysis of Minerals. Howard F. Carl and William J. Campbell, U. S. Bureau of Mines.

The flourescent X-ray spectrograph is being developed for rapid, accurate, non-destructive elemental analysis of minerals and ores. It is particularly valuable for those analyses difficult or tedious to perform by conventional chemical methods or by the usual optical spectrographic techniques.

For example, direct analyses of untreated niobium-tantalum ores are being performed by the use of internal standard techniques.

Analyses of hafnium and of zirconium may be made similarly. Analyses of selenium in ores and of both uranium and thorium in monazites have also been performed. In general, a range of concentration of about 1000 to 1 may be handled with no change in operating procedures.

A comparison is made of optical and of fluorescent X-ray spectrographic techniques and results.

An Absolute Method of Analysis by X-Ray Fluorescence Applied to Stainless Steels. Gordon E. Noakes, Ford Motor Co.

A method is proposed with which analyses may be made of alloys containing nickel, chromium, and iron in high percentages without the need of calibration curves or standards. The theory of the method is developed and equations deduced which allow rapid calculations to be performed. The method has been applied to a number of samples in which the iron, nickel, and chromium vary over wide ranges. The average error was about 5 per cent of the amount present for each element. The method could be extended to other elements in other alloys. The coefficients obtained may be used by any other laboratory. Other advantages of the method are discussed.

Use of Multichannel Recording in X-ray Fluorescent Analysis. M. F. Hasler and J. W. Kemp, Applied Research Laboratories.

The principle used so successfully in emission spectrochemical analysis and embodied in the Quantometer—multiple-channel recording—has been applied to X-ray fluorescent analysis.

A description is provided of a new multichannel filter photometer and of a new multichannel crystal spectrometer utilizing this principle. Examples are given to show the gains achieved by the use of multichannel instruments over conventional single channel instruments. These gains concern analytical speed and accuracy, plus freedom from many small secondary sources of error.

Report of Committee E-2 on Emission Spectroscopy. B. F. Scribner, Chairman.

Report of Committee E-3 on Chemical Analysis of Metals. J. W. Stillman, Chairman.

Monday, June 29 8:00 p.m. Fifth Session

Symposium on Metallic Materials at Low Temperatures *(Continued)*

Evaluation of the Significance of Charpy Tests. William S. Pellini, Naval Research Laboratory.

The problem of brittle fracture is reviewed in terms of the concepts of fracture and ductility transition. The significance of these concepts to engineering design is explained in detail. Fracture transition signifies a change in the characteristics of the metal, due to decreasing temperature, such that the propagation of brittle fractures becomes possible. Ductility transition signifies a similar change in properties such that prefracture deformation at the tips of notch defects is reduced to a nil value. Structures will operate safely at temperatures below the fracture transition if notches are not present; however, in the presence of notches the safety of the structure depends on the continued ability of the metal to develop deformation at notch tips.

It is demonstrated that the critical fracture and ductility transition temperatures of steels may be established reliably from Charpy transition-curve data and utilized in engineering design to insure the safety of structures within predetermined ranges of service temperature.

Significance of V-Notched Impact Test in Evaluation of Armor Plate. A. Hurlich, Watertown Arsenal.

The notched-bar impact test is shown to provide a measure of the ability of steel to deform plastically and absorb energy prior to and during the fracture process. Since armor must withstand the high velocity, shock impact of missiles, the notched-bar impact test provides an easily performed and relatively inexpensive nonballistic test capable of distinguishing between armor which will perform satisfactorily and armor which will exhibit brittle performance under ballistic attack. The use of the notched-bar impact test in the inspection of armor has resulted in economies in testing and has furthered the application of best metallurgical practices in the production of armor.

Notch Bend Tests for Evaluating the Properties of Weldments. R. D. Stout, Lehigh University.

Many notch-bend test methods have been proposed for the testing of welded steel. With so many specimen designs, it is difficult to assess their significance, and one may be led to underestimate or overestimate their usefulness. This confusion can be reduced in several respects. First, nearly all of the specimens lead to the same conclusions. Second, these tests show clearly the effects of important variables such as steel composition, heat treatment, and welding conditions. Third, no notch bar test can be used to predict precisely the behavior of a given engineering structure, whether welding is involved or not. Fourth, most of the confusion has resulted from varying interpretations of test results, now recognized but still not resolved. Data in the paper will support these points.

Reproducibility of Keyhole Charpy and Tear-Test Data on Laboratory Heats of Semikilled Steels. R. H. Frazier, J. W. Spretnak, and F. W. Boulger, Battelle Memorial Institute.

Eighteen heats of semikilled steel were made, processed to ¾-in. plates, and tested in the laboratory. Analytical and mechanical test data showed that good reproducibility was obtained on replicate heats. Two types of semikilled steel were used for the investigation. Standard keyhole Charpy specimens and Navy tear-test specimens were tested to determine the transition temperature separating ductile and brittle fracture. The probability of brittle fracture was not the same for the two types of steel in tests at their transition temperatures, as customarily defined. The difference was small in Charpy tests but significant in tear tests. It is concluded that notched-bar transition temperatures should be defined on the basis of a fixed probability of brittle fracture. This practice uses the data more efficiently and is more discriminating.

Effect of Specimen Preparation on Notch-Toughness Behavior of Keyhole Charpy Specimens in the Transition Temperature Zone. R. W. Vanderbeck, W. T. Lankford, S. C. Snyder, United States Steel Corp.; R. W. Lindsay, The Pennsylvania State College; H. D. Wilde, The Pennsylvania State College (now with Sharon Stationery and Supply Co.).

Numerous keyhole Charpy tests were conducted in the ductility transition temperature range of several steels, using many different specimen preparations. Behavior in the transition range was evaluated by (1) the temperature at which 50 per cent of the specimens were expected to behave in a brittle manner, called the (median) transition temperature, and by (2) the width of the transition range between 10 and 90 per cent brittle expectancy. Statistical analysis of the results indicates that the transition temperature and the width of the transition range were little affected by differences in specimen preparation. Particular care in preparing the notch did not reduce the width of the range, which was about 35 F for all steels except one that had been homogenized.

High Speed Motion Picture Study of Impact Test. H. L. Fry, Bethlehem Steel Co.

This paper summarizes the results presented in the author's paper, "An Inquiry into the Reproducibility of Impact Tests," which appeared in the ASTM BULLETIN, January, 1953, and presents further discussion of the high-speed motion pictures used to study the impact test. The paper is intended as an introduction to these motion pictures and discusses their interpretation and some of the questions raised by what the picture reveals.

(Continued in Sixth Session)

Symposium on Metallic Materials at Low Temperatures *(Continued)*

Low Temperature Impact Properties on Titanium. David E. Driscoll, Watertown Arsenal.

Titanium is a comparatively unknown metal and this paper will attempt to dispel some of the current misleading conceptions as to the usability of this metal. A brief history of titanium is outlined and some of the physical properties and impact values obtained on V notch Charpy specimens will be briefly discussed and illustrated. These will show the remarkable progress made in the yield strength, ductility, and impact properties when chemically pure titanium is alloyed with other metals.

Effect of Boron on the Impact Properties of Quenched and Tempered Steels. H. Schwartzbart and J. P. Sheehan, Armour Research Foundation.

The investigation consisted of two phases: (1) the determination of the effect of boron on the variation of transition temperature with tempering temperature, (2) the effect of boron on temper brittleness. Two grades of steel were investigated, SAE 2345 and 8120, each at four levels of boron addition.

Boron additions had the following effects: for 8120, the so-called 500 F embrittlement phenomenon is greatly minimized and shifted to higher temperatures. For 2345, the 500 F embrittlement is also lessened and shifted to higher temperatures and, in addition, the embrittlement of specimens tempered at 1200 F, commonly observed in this grade of steel, is removed.

The Notched Bar Impact Properties of Tempered Martensite in Medium Carbon, Medium Alloy Grades of Steel. M. Baeyertz, formerly with Armour Research Foundation, W. F. Craig, Sr., Climax Molybdenum Corp., and J. P. Sheehan, Armour Research Foundation.

A discussion is presented of energy and fracture criteria in the notched bar impact test, followed by a correlation of individual steel brittleness with the molybdenum–phosphorous ratio.

Low-Temperature Brittleness of Steels at High Hardness Levels. Sam Tour, Sam Tour and Co.

The problems involved in the selection of low-alloy steels containing no critical metals for use for hand tools in Arctic exposure are described. Theoretical studies of elasticity, cohesive strengths, and lattice structure of metals yielded no positive results. Studies of impact testing procedures yielded no positive results. The literature on theories of elasticity for the period 1638 to 1890 A.D. is presented in the form of 110 critical abstracts. The literature on impact testing for the period 1893 to 1945 is presented in the form of 117 critical abstracts. The literature on behavior of steels at subzero temperatures for the period 1905 to 1945 is presented in the form of 38 critical abstracts. Certain general conclusions are drawn.

Notch Sensitivity of Steels. E. J. Ripling, Case Institute of Technology.

The portion of room-temperature notch brittleness of a high strength steel which can be attributed to transition temperature behaviors was determined. An extrapolation of the super transition temperature branch of the notched tensile ductility *versus* testing-temperature curve to room temperature, indicated that practically all of the embrittlement resulted from a shift in the transition temperature.

Effect of Carbon and Nitrogen on the Tensile Deformation of High-Purity Iron at 27 C and at −196 C. Lewis D. Hall, Stanford University.

A study is described of the tensile deformation of fine-grain high-purity iron at 27 C and in liquid nitrogen, at −196 C. The effects of small additions of carbon and nitrogen, respectively, to the parent metal were investigated. It was found that carbon can lend considerable ductility to iron at the temperature of liquid nitrogen. Carbon in solution is primarily responsible for the increased ductility, although carbide precipitates may also be beneficial. Nitrogen has an embrittling effect at both temperatures, apparently as a result of the acicular nitride precipitates which act as stress concentrators.

Tension Impact Strength and Strain Distribution at Room and Sub-Zero Temperatures of Stainless and Other Steels. C. R. Mayne, V. N. Krivobok, The International Nickel Co., and C. W. Muhlenbruch, Northwestern University.

The tension impact characteristics of stainless and constructional steels have been determined at room temperatures and at −40 F, employing sheet test samples. Various gage lengths were employed, and impact resistance together with ductility was determined. The plastic yielding under impact was determined by means of grids inscribed on the samples. A discussion is offered on the characteristics of all of the steels tested in terms of energy per unit volume of the material and the significance of the plastic deformation which accompanied the tension tests. Comparison of the behavior of the various steels when tested at room temperatures or at −40 F is submitted.

The Low Temperature Properties of Cast Irons. J. S. Vanick, The International Nickel Co.

Impact tests on pearlitic, acicular, and austenitic cast iron, indicate a decrease of about 10 to 20 per cent for pearlitic irons cooled to −100 F. The decrease amounts to about 50 per cent for the same irons cooled to −300 F. The austenitic irons possess a higher order of toughness at room temperatures and retain a greater percentage of it than the pearlitic irons do at temperatures down to −300 F.

The spheroidal graphite irons also retain more toughness than flake graphite types down to −100 F.

For temperatures down to −300 F, the high strength acicular irons of the ASTM No. 50 and No. 60 grades, annealed or tempered to a hardness below 220 Brinell maximum to eliminate the unstable phase, would appear to be useful as replacements for pearlitic irons up to the No. 40 (ASTM A48 type) in applications for which No. 40 pearlitic irons are satisfactory for room-temperature service. In such cases, restrictions should be maintained upon embrittling impurities or alloys, such as excessive silicon, phosphorus, sulfur, or manganese, which affect room-temperature toughness or low-temperature stability.

The austenitic irons possess a high order of toughness and may be selected to retain this toughness and possess stability for service at room temperatures down to −300 F.

The Low Temperature Properties of Cast Iron. G. N. J. Gilbert, British Cast Iron Research Association.

The properties of 15 pearlite cast irons with varying graphite structures and chemical compositions, 5 acicular, 1 martensitic, and 11 austenitic materials, are considered. The properties of four as-cast and eight heat-treated ferritic nodular irons are also considered.

The impact and tensile properties of flake graphite pearlitic, acicular, martensitic, and austenitic cast irons at temperatures down to about −184 F are studied. Nodular irons show changes from ductile to brittle behavior in impact. The transition temperature increases with silicon and phosphorous content in the heat-treated ferritic materials and with percentage of pearlite in the as-cast materials.

Evidence is produced to show that in spite of the generally brittle character of flake graphite gray cast iron, there may be a change similar to the change from ductile to brittle failure in other materials.

Impact Properties of Ferritic Ductile Iron. R. W. Kraft, American Brake Shoe Co.

Ferritic ductile iron made to ASTM Tentative Specifications for Nodular Iron Castings (A 339–51 T) of 60,000 psi minimum tensile strength, 45,000 psi minimum yield strength, and 10 per cent minimum elongation can vary over rather wide composition and structural limits within this specification. This paper is an attempt to evaluate how these variables particularly silicon and phosphorus contents and to some extent per cent of pearlite in the microstructure, and quantity of quasi-spheroidal graphite, affect the impact characteristics. Impact tests were run on approximately 20 different heats at testing temperatures of −100 to 212 F.

Tuesday, June 30 9:00 a.m. Seventh Session

Held simultaneously with the Sixth Session

Symposium on Radioactivity in ASTM Work

Introduction. S. E. Eaton, Arthur D. Little, Inc.

About two years ago, Committee E-10 on Radioactive Isotopes was formed to promote the knowledge of the use of radioactive isotopes in materials testing, to aid and advise other technical committees of the Society interested in their use, and to perform other related appropriate functions in this field.

The Committee considered that its main initial objective was to bring to the attention of ASTM members the potential usefulness of radioactive techniques. As one step in that direction, it has assembled a bibliography of major reference sources on industrial uses of radioactive tracers. Committee E-10 is now sponsoring a Symposium entitled "Radioactivity: A Tool for ASTM?" which will give the potentialities of radioactivity for testing and measurement.

Welcome and Statement of History, Aims and Present Activities of Committee E-10 on Radioactive Isotopes. Don M. McCutcheon, Ford Motor Co.

Properties and Uses of Radioisotopes. G. D. Calkins, Battelle Memorial Institute.

The properties of radioisotopes which make them useful tools in the laboratory and factory are described. The limitations of techniques involving radioactive materials are outlined. A number of typical applications of radioisotopes are discussed. These include the uses of radioisotopes in chemical analysis, the study of wear and corrosion, the determination of cleaning efficiency, the detection of leaks, the determination of fertilizer utilization, the examination of adherence, radiography, and the measurement of thickness and density.

Applications of Radioactive Measurements to ASTM Work. O. M. Elliott, Sun Oil Co.

Radioactive tracers and radioactive measurements will not replace ingenuity, determination, and common sense in either the laboratory or the factory, but will provide greatly increased opportunities for economy, accuracy, and understanding. This paper discusses the isotope dilution method, the chromatogram-radioautograph technique, and many other cases where radioactive methods could be used to advantage in ASTM methods. ASTM should also be interested in standard referee methods for the determination of radioactive waste water and air contamination, as the quantity of radioactive isotopes used by industry becomes enormously greater. Many of the existing ASTM methods where only traces of materials are normally being measured may be fertile fields for the new tools for accuracy investigations and possibly even for process control.

Design of Radioisotope Laboratories. G. G. Manov and O. M. Bizzell, U. S. Atomic Energy Commission.

A discussion is presented of the design of radioisotope laboratories for general-purpose use. Suggestions are presented concerning the choice of flooring, walls, laboratory benches, working surfaces, fume hoods, and isotope storage containers. Cost estimates are included. A brief discussion is presented concerning the availability and procurement of radioactive materials from the Atomic Energy Commission.

(Continued in Twelfth Session)

Training Personnel in Radioisotope Techniques. Donald R. Smith, Oak Ridge Institute of Nuclear Studies.

The outline of an intensive training program for personnel is presented emphasizing the necessity for the worker to understand the fundamentals of radioactivity so that a healthy attitude will be developed toward radioisotopes and an awareness of their limitations as well as their potentialities. Safety precautions for the avoidance of radiation hazards are discussed. The need for adequate protection is stressed from the initial planning of experimental work extending to the conclusion of the test and disposal of radioactivity.

Instrumentation. E. H. Wakefield, Radiation Counter Laboratories.

This talk will summarize the paper "Nuclear Radiation—Its Detection and Measurement" which appeared in the April issue of the ASTM BULLETIN, and in addition available instruments and their application for measuring and monitoring, and special applications such as thickness area, etc., will be discussed.

Management Problems Resulting from Radioisotope Utilization by Industry. W. L. Davidson, U. S. Atomic Energy Commission.

Whenever an industrial firm decides to employ radioisotopes in the laboratory or factory, the management is faced with some novel questions. Topics which will be discussed include: (*a*) legal restrictions associated with the use of radioisotopes, (*b*) patentability of ideas developed as a result of isotope utilization, (*c*) AEC handling of company confidential disclosures, (*d*) insurance problems raised in connection with isotopes uses, and (*e*) revised interpretation of publication requirement.

Tuesday, June 30 11:30 a.m. Eighth Session

Held simultaneously with the Ninth Session

Report Session

Report of D-3 on Gaseous Fuels. A. W. Gauger, Chairman.

Report of D-5 on Coal and Coke. W. W. Anderson, Chairman.

Report of D-7 on Wood. L. J. Markwardt, Chairman.

Report of D-10 on Shipping Containers.

Report of D-21 on Wax Polishes and Related Material. W. W. Walton, Chairman.

Report of D-22 on Methods of Atmospheric Sampling and Analysis. L. C. McCabe, Chairman.

Report of D-23 on Cellulose and Cellulose Derivatives. F. A. Simmonds, Chairman.

Tuesday, June 30 11:30 a.m. Ninth Session

Held simultaneously with the Eighth Session

Report Session

Report of B-1 on Wires for Electrical Conductors. D. Halloran, Chairman.

Report of B-4 on Electrical Heating, Resistance, and Related Alloys. S. A. Standing, Chairman.

Report of B-5 on Copper and Copper Alloys, Cast and Wrought. G. H. Harnden, Chairman.

Report of B-8 on Electrodeposited Metallic Coatings. C. H. Sample, Chairman.

Report of B-9 on Metal Powders and Metal Powder Products. F. V. Lenel, Chairman.

Report of C-3 on Chemical-Resistant Mortars. Beaumont Thomas, Chairman.

Report of C-4 on Clay Pipe. J. C. Riedel, Chairman.

Tuesday, June 30 12:00 p.m. Tenth Session

Luncheon Session—President's Address, 40- and 50-Year Memberships, Award of Merit, Introduction of New Officers

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Tuesday, June 30 2:00 p.m. Eleventh Session

Held simultaneously with the Twelfth, Thirteenth, and Fourteenth Sessions

Report Session

Report of A-2 on Wrought Iron. A. D. Morris, Chairman.

Report of A-3 on Cast Iron. J. S. Vanick, Chairman.

Report of A-6 on Magnetic Properties. R. L. Sanford, Chairman.

Report of A-7 on Malleable-Iron Castings. W. A. Kennedy, Chairman.

Report of B-2 on Non-Ferrous Metals and Alloys. Bruce W. Gonser, Chairman.

Tuesday, June 30 2:00 p.m. Twelfth Session

Held simultaneously with the Eleventh, Thirteenth, and Fourteenth Sessions

Symposium on Radioactivity in ASTM Work *(Continued)*

Atomic Energy Commission Movie on "Methodology." G. G. Manov, U. S. Atomic Energy Commission.

"Methodology" opens with a historical sequence showing the early work of Hevesy in studying plant metabolism. The remainder of the film deals with the following criteria for setting up a tracer experiment: (1) radiochemical purity, (2) single chemical state, (3) elimination of exchange error, (4) knowledge of the degree to which the labeled molecules remain intact, (5) avoidance of isotope effect, (6) avoidance of chemical effects, and (7) avoidance of radiation effects. The film also illustrates the relative importance of economy of time, economy of materials, and the accuracy required.

Demonstration Period.

Absorption and Backscatter Types of Beta Ray Thickness Gages. J. Pennock, Tracerlab, Inc.

Radioisotopes in Radiography. D. T. O'Connor, Naval Ordnance Laboratories.

Beta Ray Hydrogen Carbon Ratio Analyzer. R. B. Jacobs, Standard Oil Company of Indiana and H. M. Sullivan, Central Scientific Co.

Radiolabeled Dirt in Cleaning Tests. O. K. Neville, Nuclear Instrument and Chemical Corp.

Panel Discussion.

The panel will consist of previous speakers with other selected ASTM committee members. The purpose is to give other ASTM committees a chance to tell of their activities, plans, or thoughts, on using radioactivity; for previous speakers to answer further questions from the floor; and for summarizing the day's deliberations.

Exhibit. A small exhibit of representative instruments and equipments is being planned for continuous showing throughout the day as listed below.

Beta Gages and Radiographic Equipment. Tracerlab, Inc.

Comolete Display of Radiation Detectors; Geiger, Proportional, Scintillation Ion Chamber for Liquids, Solids, and Gases. Radiation Counter Laboratories, Inc.

Scintillation Counter, Radiation Monitor, and Scintilletion Portable Probe. General Electric Co.

One Laboratory Type Radioisotope Analyzer System. Nuclear Instrument and Chemical Corp.

Tuesday, June 30 2:30 p.m. Thirteenth Session

Held simultaneously with the Eleventh, Twelfth, and Fourteenth Sessions

Symposium on Techniques for Electron Metallography

Introduction. C. M. Schwartz, Battelle Memorial Institute.

The electron microscope is a powerful tool for the investigation of submicroscopical structure. Its capabilities have been clearly demonstrated in numerous applications to a variety of research problems. In its present state of development, however, it must be used as a transmission microscope. In order to employ this instrument for the study of the structure of opaque materials, such as metallurgical specimens, special techniques are needed. As in the case of optical metallography, the structure is delineated by suitable etching methods. The etched structure is regenerated in an extremely thin "replica"; this must be transparent to the electron stream which constitutes the illumination. The replication process is necessarily complex, and depends for its success upon critical attention to details of specimen preparation.

The many techniques which have been developed to date are evidence of the ingenuity displayed in striving toward a true representation of structure. None of these, perhaps, meets all of the requirements. Nevertheless, the results show promise of eventual attainment of this goal, within practical limits. The purpose of this symposium is to present examples of techniques in common use or of potential value, in the hope that increased interest in the application of electron microscopy to metallurgical problems will result.

Techniques Used in Electron Microscopy of Aluminum Alloys. F. Keller and M. S. Hunter, Aluminum Company of America.

Techniques useful for the electron metallography of aluminum alloys are discussed, with particular reference to the aluminum oxide replica technique. The advantages of chemical polishing over conventional polishing methods are discussed and the details of recent methods for preparing oxide film replicas are given. A triple replica method which uses a plastic replica, an evaporated aluminum replica, and an oxide film replica is described. This method, which is applicable to other alloys as well as those of aluminum, may be used to follow changes in surface structure which occur during testing.

Techniques for the Study of Precipitated Carbides. W. D. Forgeng and John L. Lamont, Union Carbide & Carbon Research Laboratories, Inc.

Techniques for replication of steel surfaces with plastic films were modified to be more useful for the delineation of carbide phases in alloy steels, particularly when the metallographic specimens were deeply etched or submitted to corrosion tests. The modified procedures are described and typical results are shown. The results obtained by electron microscopy are compared and correlated with optical studies of the metal surfaces and isolated carbide particles.

Inorganic Replication: Interpretation of Electron Micrographs. C. J. Calbick, Bell Telephone Laboratories, Inc.

Inorganic replicas produced by evaporation onto or surface oxidation of a specimen have a calculable *intrinsic resolution* d, which is usually larger than instrumental resolution. Geometrical conditions of film formation and observation determine d, which varies locally with surface topography. Micrograph quality depends on d and on a suitably wide range of photographic density. An optimum average mass thickness for replicas therefore exists. Inorganic replicas possess good dimensional stability, which permits stereoscopic micrography with its fundamental advantage of three-dimensional visualization. Great stress is laid upon the use of stereomicrography as an interpretative tool.

(Continued in Seventeenth Session)

Electron Microstructure of Steel by "Extraction Replica" Technique. R. M. Fisher, U. S. Steel Corp.

A recently developed replica technique for electron metallography will be described and illustrated with electron micrographs. In this replica technique, carbide particles projecting from the surface of the polished and etched specimens are stripped off with the replica film by etching the specimens a second time through the plastic. Thus the replica contains the actual carbide particles avoiding the loss of resolution inherent in any other replica technique. Electron micrographs will illustrate the results of using this technique on the series of standard specimens previously examined by Subcommittee XI of ASTM Committee E-4.

Tuesday, June 30 2:30 p.m. Fourteenth Session

Held simultaneously with the Eleventh, Twelfth, and Thirteenth Sessions

Steel

Properties and Behavior of a High-Strength Rivet Steel. Frank Baron and Edward W. Larson, Jr., Northwestern University.

A high-strength rivet steel is reported herein which has certain advantages over other rivet steels meeting the requirements of the Tentative Specification for High-Strength Structural Rivet Steel (A 195 – 52T). The high-strength rivet steel is as ductile and is driven as easily and quickly as ordinary carbon rivet steel.

The behavior in static tension and in fatigue of butt joints fastened with rivets of the high-strength low-alloy steel was compared to that of joints fastened with rivets of ordinary carbon steel. For static loads, the efficiencies of the joints were about the same irrespective of the kind of rivet steel. The fatigue strengths of joints having a 1$^{9}/_{16}$-in. length of grip were about the same irrespective of the kind of rivet steel. However, at longer lengths of grip, the fatigue strengths of the joints fastened with the high-strength rivets were greater than for similar joints fastened with ordinary carbon steel rivets. It was also observed that a decrease in the ratio of tension to shear of riveted joints can result in a decrease in the fatigue strengths of such joints.

The Influence of Strain Rate and Temperature on the Strength and Ductility of Mild Steel in Torsion. C. E. Work and T. J. Dolan, University of Illinois.

Cylindrical specimens of SAE 1018 steel were tested in torsion at four different constant strain rates from 0.0001 in. per in. per sec to 12.5 in. per in. per sec and at room temperature, 400, 700, and 1000 F. Torque, angle of twist, and time were continuously recorded and the torsional properties determined. The detailed results are presented in three-dimensional charts and analyzed in terms of mechanisms altering the material behavior. The experimental observations are compared with several theories that have been proposed to express mathematically the effects of strain rate and temperature on mechanical properties.

Creep and Creep-Rupture of Some Ferritic Steels Containing 5% to 17% Chromium. E. J. Dulis and G. V. Smith, United States Steel Co.

Data on creep and creep-rupture properties are presented for eleven steels ranging in alloy content from 5 Cr-½ Mo to 17 Cr, with additions of silicon, titanium, columbium, or boron to some. Microstructural changes, observed after test, including carbide spheroidization and recrystallization, are described. Some observations on the mechanism of flow and fracture of ferritic and austenitic steels are included.

Influence of Sharp Notches on the Stress-Rupture Characteristics of Heat-Resisting Alloys: Part II. W. F. Brown, Jr., M. H. Jones, and D. P. Newman, NACA-Lewis Flight Propulsion Lab.

This paper is a summary of the research work carried out at the Lewis Laboratory of the NACA regarding the influence of sharp notches on the stress-rupture characteristics of various heat-resisting alloys.

The alloys discussed include ferritic low-alloy steels, ferritic stainless steels and high-temperature alloys. Each alloy has been investigated over the range of temperatures which have the greatest commercial interest.

The data are analyzed to reveal the influence of alloy composition, the time-temperature dependence of the notch effect and the influence of ductility. In addition, an attempt is made to outline the significance of these results to the designer.

(Continued in Thirty-second Session)

Time-Temperature Dependence of the Notch Effect and Influence of Notch Depth in Stress Rupture Tests on a Cr-Mo-V Steel. D. P. Newman, M. H. Jones, and W. F. Brown, Jr., NACA-Lewis Flight Propulsion Lab.

Notch and smooth bar stress-rupture tests have been made over a wide range of temperatures and stresses for a Cr-Mo-V steel. These data are analyzed to reveal the time-temperature dependence of notch sensitivity in this steel. In addition hardness tests are reported which confirm the previously advanced hypothesis that a time-temperature dependent structural change is responsible for the embrittlement.

The influence of notch depth on this alloy at 1100 F has been defined by systematic tests covering a range of notch depths between 5 and 84 per cent for a constant notch sharpness of 150.

An Investigation of the Time-Temperature Parameters for Extrapolation of Stress-Rupture Data. S. S. Manson and W. F. Brown, Jr., NACA-Lewis Flight Propulsion Lab.

Recently, there has been considerable interest in time-temperature relations which permit the extrapolation and interpolation of stress-rupture data. Two time-temperature parameters have been proposed: (1) in the form of $(T + 460)(20 + \log t)$ by Larson and Miller, and (2) in the form of $(T - T_a)(\log t - \log t_a)^{-1}$ by Manson and Haferd.

In the present report, an analytical treatment is presented to derive a more general time-temperature parameter. Experimental data at constant normal stress have been obtained for several alloys for the purpose of verifying the analysis. The possibility of extrapolation of data below 300 hr to predict rupture times up to at least 10,000 hr is examined.

Tuesday, June 30 4:30 p.m. Fifteenth Session

Gillett Memorial Lecture

Micrometallurgy. Jerome Strauss, Vice President Vanadium Corporation of America.

This Lecture, established in 1951, is jointly sponsored by ASTM with Battelle Memorial Institute. It commemorates Horace W. Gillett, one of America's leading technologists and metallurgists and the first Director of Battelle. The Lecture is delivered annually at a meeting of the Society, the first one having been given at the Fiftieth Anniversary Meeting, June, 1952. The Lecture will cover subjects pertaining to the development, testing, evaluation, and application of metals.

Tuesday, June 30 8:00 p.m. Sixteenth Session

Held simultaneously with the Seventeenth and Eighteenth Sessions

Fatigue

Report of Committee E-9 on Fatigue. R. E. Peterson, Chairman.

The Effect of Range of Stress on Fatigue Strength of SAE 4340 Steel in Bending and Torsion With and Without a Notch. W. N. Findley, University of Illinois.

Fatigue data are presented for SAE 4340 steel hardened to Rockwell C 38. The data include results of tests at different values of mean stress in bending and in torsion for both notched and unnotched specimens.

Since some of the mean stresses employed were such as to produce yielding, the stress distribution resulting from yielding was analyzed to determine the actual stresses employed.

The mechanism of failure and effect of notches are discussed and compared with the literature on this subject.

Influence of Grain Size on Fatigue Notch-Sensitivity. R. W. Karry and T. J. Dolan, University of Illinois.

A study was made of the reduction in fatigue strength caused by circumferential notches in specimens of 70–30 brass processed to obtain three different degrees of cold reduction and three different annealed grain sizes. The fatigue strength reduction factor and notch sensitivity were dependent upon both the grain size of the metal and the notch root-radius. An increase in grain size produced a significant lowering of the fatigue strength, but also resulted in a decrease of notch-sensitivity and fatigue strength reduction factor. Experimentally determined fatigue strength reduction factors were somewhat smaller than those computed from H. Neuber's theory.

Static and Fatigue Properties of Carbon, Silicon, and High-Strength Low-Alloy Steel Plates Having a Hole. Frank Baron and Edward W. Larson, Jr., Northwestern University.

The initial purposes of the investigation were to determine the fatigue strengths of various high-strength low-alloy steels and to determine if any of these steels had a marked advantage in resisting fatigue loadings.

(Continued in Twenty-first Session)

Strength Properties of Rolled Aluminum Alloys Under Various Combinations of Alternating and Mean Axial Fatigue Stresses. B. J. Lazan and A. A. Blatherwick, University of Minnesota.

The behavior of rolled aluminum alloys 14S-T6, 24S-T4, and 75S-T6 under axial fatigue stresses is analyzed by presenting the data in the form of S-N curves for each of several stress ratios. Stress-range diagrams are employed to indicate the effect of varying the combinations of mean and alternating stresses. Three types of notched specimens, with different degrees of stress concentration, as well as an unnotched type were used to investigate the effect of stress raisers on fatigue strength. The resulting data are analyzed by diagrams showing the manner of variation of the fatigue strength-reduction factor with stress ratio, stress level, and life.

Tuesday, June 30 8:00 p.m. Seventeenth Session

Held simultaneously with the Sixteenth and Eighteenth Sessions

Symposium on Techniques for Electron Metallography *(Continued)*

Report of Committee E-4 on Metallography. L. L. Wyman, Chairman.

Symposium on Electron Metallography

Techniques for Ferrous Electron Metallography—I. Silica and Plastic Replicas. II. Etchants and Etch Depth. W. L. Grube, General Motors Corp.

The work of Subcommittee XI on Electron Microstructure of Steel of Committee E-4 on Metallography has been directed toward the development of techniques for replication of carbon steel which would be reproducible and reliable, and which could be interpreted on the basis of metallographic experience. The procedure adopted for the investigations described in the previous reports included the use of shadow-cast negative plastic replicas and picral etchant. This paper describes the results of a re-examination of techniques, for the purpose of determining whether others could be found more nearly satisfying the stated requirements. Specifically, electron micrographs of plastic replicas of heat-treated specimens of eutectoid carbon steel will be compared with electron micrographs of positive silica replicas of the same specimens. The effect of variation of etchant and of etch depth will be discussed.

Metal-Shadowing for Contrast Enhancement—Comparison of Shadow Metal and Shadow Angle. D. M. Teague, Chrysler Corp.

The use of evaporated metallic deposits to enhance replica contrast and to delineate surface contour is of unquestioned value for electron metallography. The effects of variation of shadow metal and of shadow angle are discussed in relation to satisfactory resolution of fine structure such as is found in low-temperature transformation products in heat-treated steel.

Specimen Polishing Techniques for Electron Metallography of Steel. W. L. Grube and S. R. Rouze, General Motors Corp.

Metallographic polishing techniques for electron microscopy are subject to stringent requirements as to quality. It is essential to prepare the surface without relief effects and free from distortion of flowed metal. This permits use of light etching to reveal fine-scale microstructure under the electron microscope. The techniques used to attain a satisfactory polish and the factors which affect the ultimate quality are discussed. A summary of polishing techniques used by members of ASTM Subcommittee XI on Electron Microstructure of Steel of E-4 on Metallography is included.

Techniques Which Permit Successive Examinations of Specific Areas by Electron Microscopy. F. A. McLauchlan, U. S. Steel Co.

Several methods have been employed which make it possible to select a specific area of a specimen for successive examinations with the electron microscope. A new method is described whereby successive replicas are mounted on 200-mesh "athene" screens in such a manner that corresponding squares in the screens contain replicas of the same areas. The athene screens are marked at their centers so that corresponding squares in successive mounts are easily located when the mounts are in the electron microscope. Several micrographs are shown to illustrate the technique, and some of the possible applications of the technique are reviewed.

The Washing of Electron Microscope Replicas of Surfaces. E. F. Fullam, General Electric Co.

In the preparation of double replicas such as the plastic-silica type, frequent rupture of the thin film occurs upon the removal of the thick plastic replica with solvents. The breaking of the film occurs usually either upon immersion of the films in the solvent due to swelling, or at the moment of the last evaporation of the liquid due to surface forces. Depending on the type of replica being prepared, this difficulty in washing may be greatly minimized through the use of the Jaffee method with naphthalene, a vapor condensation method, or a low-temperature method. The methods may also be used in various combinations.

A description will be given of the techniques and apparatus found to be useful in the preparation of thin replica films. Also modifications of the washing techniques will be presented having application to the more unusual samples.

Determination of Surface Properties for a Eutectoid Steel and Iron as Prepared by the Conventional Metallographic Techniques of Abrading, Mechanical Polishing, and Chemical Etching. C. F. Tufts, Sylvania Electric Products Inc.

The high useful magnifications employed in electron microscopy make it imperative that the sample surface under examination exhibit precise fidelity with respect to the bulk specimen. If this requirement is ignored, artifacts may be interpreted as real structure and false interpretations reported. This work investigated the effects upon structure and geometry at the surface of a eutectoid steel specimen and a spectrographically pure α iron specimen when these materials were subjected to the following treatments:

1. Abrasion with metallographic emery paper.
2. Mechanical polishing employing γ Al_2O_3 (0 to 2 μ in particle size).
3. Mechanical polishing employing diamond powder (0 to 2 μ in particle size).
4. Effects of cyclic mechanical polishing.
5. Surface structure produced by etching mechanically polished specimens with the following:
   (*a*) Picral (4 per cent picric acid in 95 per cent ethyl alcohol activated with zephiran chloride).
   (*b*) Ferric Chloride = Hydrochloric acid (1 per cent HCl and 2 per cent $FeCl_3$ in 95 per cent ethyl alcohol).

Electron diffraction was the principal tool employed. Light microscopy, X-ray diffraction, and electron microscopy were employed as supplementary techniques. The data obtained, including diffraction patterns and micrographs, are presented and discussed.

Application of Unconventional Etchants for Delineation of Fine Structure. Alfred E. Austin, Battelle Memorial Institute.

It has been shown that very light etching of carefully polished specimens yields replicas best capable of revealing fine structure. Furthermore, light etching is essential, in the case of highly disorganized structures such as bainite, to avoid overlap of structure and to permit proper interpretation. The possibility was explored of using etchants for steel other than picral or nital, in particular, reagents of considerably reduced reactivity. Application of controlled etching to the problem of lineal analysis is described.

Comparison of Positive versus Negative Plastic Replicas. C. M. Schwartz, Battelle Memorial Institute.

The relative merits of a two-step plastic positive replica technique, compared with the conventional plastic negative replica, are presented. Problems of preparation, interpretation, and resolution are compared for structures of varying complexity.

Tuesday, June 30 8:00 p.m. Eighteenth Session

Held simultaneously with the Sixteenth and Seventeenth Sessions

Session on Significance of Tests of Concrete

Introduction. W. H. Price, Bureau of Reclamation.

Tests employed for measuring properties of concrete and for evaluating procedures used in its construction should be constantly examined in the light of increased knowledge and new developments. Such scrutiny will result in a fuller understanding of this complex material, improvements in existing test methods, and encouragement of much-needed research. The significance of some tests that are currently prominent are discussed in the contributions offered for this session. These reports are recommended for study for the information supplied and the pertinence of the tests discussed.

Porosity Determinations and the Significance of Pore Characteristics of Aggregates. K. B. Woods, D. W. Lewis, and W. L. Dolch, Purdue University.

This paper has been developed from material obtained from a review of the literature covering research data collected from the laboratory and the field. The historical aspects of the paper include references in the fields of building stone, brick and aggregates used in portland cement concrete. Attention is directed toward various methods of test which have been employed for determining the characteristics of pores, and emphasis is given to the relationship of these characteristics to absorption, the degree of saturation, and the durability of concrete.

It is concluded that the abundance, shape, size, and continuity of pores influence the physical properties and the chemical stability of aggregates and control certain durability characteristics of portland cement concrete. It is concluded further that there is a definite need for research in connection with the development of methods of test for the determination of pore characteristics.

Significance of Tests for Chemical Reactions of Aggregates in Concrete. William Lerch, Portland Cement Assn.

Publication in 1940 of a paper by T. E. Stanton, entitled "Expansion of Concrete Through Reaction Between Cement and Aggregate," aroused widespread interest in the problem of chemical reactions of aggregates in concrete. Since that time numerous papers have been published on this subject and tests have been developed to determine the potential reactivity of aggregates in concrete. Three of these methods of test have been adopted as ASTM Tentative Methods, and others have been proposed and are receiving further study. Some of these methods can be used also for testing inhibitors that may prove useful in preventing adverse chemical reactions. The paper discusses the significance of the various tests that have been proposed.

Significance of Tests on Sulfate Resistance of Concrete. Elmo C. Higginson and Omar J. Glantz, Bureau of Reclamation.

This paper discusses the various testing methods and types of specimens which have been employed in both the laboratory and field to evaluate the resistance of concrete to sulfate attack. The conclusions drawn from these investigations show that greater resistance of concrete to sulfate attack can be obtained by the use of increased cement contents and cements which contain small percentages of tricalcium aluminate. Calcium chloride reduces the resistance of concrete to sulfate attack. Test data also show a need for a standard testing method, and that the effects of air-entraining agents, pozzolans, and other admixtures on the sulfate resistance of concrete have not yet been well established.

Wear Tests of Concrete. H. L. Kennedy and M. E. Prior, Dewey and Almy Chemical Co.

The types of concrete surface wear are divided into four general classifications and the application of various methods of test to these groups is discussed. The merits of the methods and the effects of surface treatments on wear resistance are considered. The results of the investigation indicate that because of the many factors involved, it is impossible at present to utilize any one test method for evaluating all types of wear. Present information indicates that wear tests by rubbing, shot blast, or dressing wheel methods are most reliable.

Pulse Velocity Testing of Concrete. R. B. Young, Hydro Electric Power Commission of Ontario.

An outline is provided of pulse velocity techniques and experience gained in their use in testing concrete in Europe and America. Data are presented showing the effect on velocity readings of setting behavior, strength developing, cracking, deterioration, water content, and other factors. Potentialities and limitations disclosed by experience are discussed.

Evaluation of Curing Compounds for Portland Cement Concrete. C. E. Proudley, North Carolina State Highway and Public Works Commission.

Desirable characteristics of curing compounds for use on highways and structures are enumerated and laboratory tests simulating field conditions for the purpose of evaluating liquid, membrane-forming compounds are described. Factors affecting the correlation between laboratory tests and service performance are discussed, and also difficulties encountered in securing uniformity among testing laboratories under the present test methods. Influence of job operations and climatic conditions upon the performance of curing compounds is touched upon briefly and some opinions are expressed regarding the relative merits of several methods of curing concrete.

Wednesday, July 1 9:00 a.m. Nineteenth Session

Held simultaneously with the Twentieth and Twenty-first Sessions

Atmospheric Sampling, Water, and Simulated Testing

Report of Committee D-22 on Methods of Atmospheric Sampling and Analysis. L. C. McCabe, Chairman.

Atmospheric Sampling and Analysis

Introduction. H. H. Schrenk, Industrial Hygiene Foundation.

Three papers will be presented at this session. One deals with the properties of various types of air filtration media for particulate matter. Properties such as flow resistance characteristics, particle retention by size and amounts, particle penetration, and physical and chemical properties will be discussed in relation to sampling needs.

The second paper describes the instrumentation and analytical techniques in use in a comprehensive study of air pollution in the Detroit-Windsor area. Four major types of measurements are discussed, those relating to (*a*) meteorology; (*b*) gaseous contaminants; (*c*) aerosols; and (*d*) light transmission.

The third paper presents results of an investigation of various factors that are significant in obtaining satisfactory dust fall measurements. A method for classifying data to permit valid comparison of results from different cities and recommendations for a standard procedure is offered.

Properties of Various Filtering Media for Atmospheric Dust Sampling. Walter J. Smith, Arthur D. Little, Inc.

In the sampling of air for analysis of particulate matter a number of filtration media are available and in use. However, there is often uncertainty as to which medium is best suited for a given situation. The purpose of this paper is to present and compare the properties of various air filtration media and to discuss their properties in relation to various air sampling needs.

The media considered include: chemical filter papers, high efficiency and other special filters, mineral fiber types, synthetic fiber types, Millipore filters, and ceramic plate types.

Filter properties include: flow-resistance characteristics, particle retention by size and amount, particle penetration, and physical and chemical properties of the medium that relate to its use as an assay filter.

Some Instrumentation and Analytical Techniques for the Continuous Evaluation of Air Contaminants. Morris Katz, National Research Council of Canada.

This paper describes the instrumentation and analytical techniques used in the study of air pollution in the Windsor-Detroit area by a Technical Advisory Board under the terms of a joint reference submitted by the Governments of Canada and the United States to the International Joint Commission in 1949. The methods of study of the atmosphere which are discussed include the determination of (*a*) meteorological factors such as wind direction, velocity, solar radiation, rainfall, and lapse rates; (*b*) gaseous contaminants such as sulfur dioxide, hydrogen sulfide, oxides of nitrogen, chlorine, hydrogen fluoride, aldehydes and ozone; (*c*) aerosol contaminants by continuous paper filtration techniques followed by identification by chemical analysis, spectrographic analysis, and X-ray diffraction; (*d*) recording optical method for light transmission in atmosphere as affected by air pollution.

Nature and Interpretation of Monthly Dust Fall Measurements. J. Deane Sensenbaugh and W. C. L. Hemeon, Industrial Hygiene Foundation of America, Inc.

Results of an investigation of variables involved in making dust fall measurements include the inherent error associated with a single observation, the effect of jar elevation, the magnitude of the water-soluble fraction, the effect of a wet bottom compared with a dry bottom, and the effect of jar dimensions. A discussion and illustration of a method for classifying the data to permit valid comparison of results obtained in different cities, and recommendations for standard procedures are offered.

A Comparison of Methods of Testing for Dissolved Oxygen in Waters of High Purity. Walter L. Riedel, Consolidated Gas Electric Light and Power Company of Baltimore.

An investigation of several methods of testing for dissolved oxygen, in a high purity water, was conducted under the sponsorship of The Dissolved Oxygen Subsection, Subcommittee IV on Methods of Analysis, ASTM Committee D-19 on Industrial Water. The methods studied were the referee and non-referee methods of ASTM Tentative Methods of Test for Dissolved Oxygen in Industrial Water (D 888 – 49 T) and the Schwartz-Gurney B procedure with dead stop, potentiometric, and starch titrations. A deaerated feedwater, low in dissolved oxygen and organic or inorganic materials, was used as the basic sample. Organic and inorganic materials were introduced for positive and negative interferences separately, and an air saturated solution added to increase the dissolved oxygen content.

A statistical technique, the analysis of variance, was applied to the data collected and furnished a basis for various conclusions as to the precision of the methods.

Philosophy of Simulated Service Testing. S. A. Gordon, Battelle Memorial Institute.

Simulated service testing requires a complete knowledge of the product, its environment, and operational history. To collect such knowledge is rather difficult unless some philosophy is followed in which the scope of the environment has been established and the important operational factors identified. It is the purpose of this paper to attempt to clarify the philosophy best suited in order to get the best results from a simulated service test.

Wednesday, July 1 9:00 a.m. Twentieth Session

Held simultaneously with the Nineteenth and Twenty-first Sessions

Symposium on Lateral Pile Load Tests

Introduction. A. E. Cummings, Raymond Concrete Pile Co.

A problem that often occurs in the design of pile foundations concerns the ability of the piles to resist lateral force applied at the pile heads. For many years engineers have been making field tests on full size piles and laboratory tests on model piles to investigate the behavior of the piles under this type of loading. Very little of these test data has ever been published so that there is almost no literature available on the subject. Furthermore, the tests were performed in many different ways and there is no method of test that even approximates a standard procedure. This symposium has been sponsored by Committee D-18 on Soils for Engineering Purposes for the purpose of making actual test data available to the profession. It is the expectation of the committee that the material presented during the symposium will lead to the development of a standard procedure for making tests of this type.

Resistance of Long Hollow Piles to Applied Lateral Loads. G. A. McCammon and J. C. Ascherman, Creole Petroleum Corp.

For many years, reinforced concrete piles have been driven into the bottom of Lake Maracaibo, Venezuela, to support the drilling rigs used in developing one of the world's most prolific oil reservoirs. This paper discusses the data obtained from tests in which special hollow piles or caissons were loaded at the top with static lateral loads. The results indicate that the plastic clay into which the caissons penetrate acts as an elastic medium when resisting lateral forces. Also, the point of maximum moment occurs very near the surface of the soil, even though the soil penetration is large.

Lateral Load Tests on Groups of Battered and Vertical Piles, Lock No. 25, Mississippi River. Lawrence B. Feagin, Corps of Engineers.

Tests conducted at Lock No. 25, Mississippi River, by the Corps of Engineers, for the purpose of determining for design purposes the relative resistance to lateral loads of various arrangements of groups of battered and vertical piles with heads fixed in concrete test monoliths are described, and the results are presented and discussed. The various groupings tested included two of all-vertical piles, two of all-battered piles, and four combinations of vertical and battered piles. The tests included lateral loads applied both in the direction of the pile batter and in the opposite direction, with and without vertical load. Conclusions are presented as to the relative effect of battered piles and their arrangement in improving resistance to lateral load.

Lateral Load Tests on Vertical Fixed-Head Pile, Lock No. 25, Mississippi River. S. M. Gleser, Corps of Engineers.

The shape assumed by a fixed-head pile when subjected to lateral load has long been a subject of conjecture. Tests made at Lock 25, Mississippi River, on a monolith capping seven vertical wood piles, and a hollow steel pile subjected to vertical and lateral loads are described, including special instrumentation employed to measure deflections throughout the length of the hollow pile under load, and results are discussed. Also included is a theoretical analysis of the action of the pile and its comparison with actual movements under load and with other existing theoretical solutions.

Bearing Piles Subjected to Horizontal Loads. L. T. Evans, Foundation Engineer, Los Angeles.

(Continued in Twenty-third Session)

Wednesday, July 1 9:00 a.m. Twenty-first Session

Held simultaneously with the Nineteenth and Twentieth Sessions

Fatigue (*Continued*)

An Investigation of the Effects of Overstress on the Fatigue Characteristics of Certain Wrought Sheet Magnesium Alloys. Joseph Viglione and Forrest S. Williams, Naval Air Material Center.

In this investigation the effects of overstressing cold rolled AZ61X magnesium alloy (Dow J-1h) and AZ31X magnesium alloy (Dow FS-1h) have been determined and correlated with the location of the damage line. It was found that these magnesium alloys were damaged in fatigue by understressing as well as by overstressing, whenever the prestress condition was above the damage line. The damage effect was discovered to be greatest at the higher prestress levels, leading to the conclusion that the amount of damage is more a consequence of the magnitude of the prestress than of the number of stress applications. It was also shown that the fatigue strength and the fatigue life of these alloys were neither raised nor extended by prior understressing below the damage line. The tensile properties seemed to be unchanged by prestressing occurring either above or below the damage line.

Investigation of Prot Accelerated Fatigue Test. E. J. Ward, D. C. Schwartz, and R. T. Schwartz, Wright Air Development Center.

Prot has proposed a method of accelerated fatigue testing consisting of continuously increasing the cyclic stress until failure occurs. Specimens are tested at several rates of increasing stress and the failure stresses are plotted against the square root of the rate. Prot proposed that a straight line drawn through the failure stresses will intersect the zero rate at the endurance limit. This procedure was found to predict satisfactorily the mean endurance limit of both virgin and welded SAE 4340 steel. The method was extended in an attempt to utilize statistical analysis of the data to estimate scatter of stress at the endurance limit. A good estimate of the scatter for the virgin material was obtained, but the scatter prediction for the welded material was not as good.

Elevated Temperature Fatigue Properties of SAE 4340 Steel. W. J. Trapp and R. T. Schwartz, Wright Air Development Center.

An investigation was made of the fatigue properties in axial loading of SAE 4340 steel at room temperature, 600, 800, and 1000 F, for a range of ratios of alternating to mean stress and for both smooth and notched specimens. The results are presented in several types of modified Goodman diagrams. Some dynamic creep measurements were made during fatigue tests.

The fatigue notch-sensitivity factor generally decreased with increasing stress-level, decreasing stress-ratio, and increasing temperature, except that the fatigue notch-sensitivity at 600 F was found to be higher than at any of the other temperatures.

Dynamic creep was dependent upon mean stress rather than maximum stress. Two distinct types of creep curves were obtained, determined by stress-ratio, mean stress, and temperature.

Damping, Elasticity, and Fatigue Properties of Unnotched and Notched N-155 as Room and Elevated Temperatures. L. J. Demer and B. J. Lazan, University of Minnesota.

Data are presented on the damping, elasticity, and fatigue properties of N-155 under rotating bending stress. Properties at room temperature, 1350 and 1500 F obtained from unnotched and notched specimens are compared. Changes in vertical deflection and run-out for notched specimens are associated with formation of fatigue cracks. "First-evidence-of-crack" curves plotted against stress are compared with the usual S-N fracture diagrams. Effective stress concentration values determined from such crack data are nearly independent of the number of fatigue cycles. Data are also presented for both unnotched and notched specimens on the dynamic proportional limit and its relationship to the fatigue strength.

Testing Machine for Random Fatigue Testing. A. M. Freudenthal, Columbia University.

A high-speed rotating beam fatigue testing machine is described that has been developed for the testing of small specimens under a random time-series of six-load-levels, derived from an exponential distribution of load impulses. The load sequence is produced by changing the current in a moving coil situated in the gap of a strong permanent magnet. The variable of the test-series is the frequency of the highest load-level. Some test results for 75-S-T aluminum alloy are reported and compared with results of conventional fatigue tests.

Papers on Bituminous Waterproofing and Roofing Materials—Wednesday, July 1, 9:00 a.m.

At a special technical paper section of the meeting of Committee D-8 on Bituminous Waterproofing and Roofing Materials, scheduled for 9:00 a.m., the following three papers will be given:

Preparation of Bituminous Films by Spinning. Lawrence R. Kleinschmidt, Bureau of Standards.

A method is described for the preparation of test coatings by spinning of asphalts, coal-tar pitches, and other solid materials not having fixed melting points, and which will liquefy under 450 F. The method was most effective where a series of coatings was required varying by small increments in thickness. A large number of test specimens can be prepared from a minimum quantity of material in a relatively short time, since no clean-up is required during the coating operation. Coating thicknesses are controlled chiefly by the temperature of the material and the speed of rotation of the test disk. Coatings have been prepared by this method from blow petroleum asphalts in thicknesses ranging from 0.0005 to 0.05 in.

A Method of Preparing Uniform Films of Bituminous Films. Sidney H. Greenfeld, Bureau of Standards.

A hydraulic press was adapted to the preparation of thin films of both stabilized and unstabilized bitumens for exposure out-of-doors and to accelerated durability tests. Films in the range of 0.005 to 0.050 in. were made consistently within a maximum variation of ±0.001 in. in each film with fewer than 10 per cent rejections. Coatings up to 0.100 in. thick can also be made.

Effects of Thermal Shock on the Durability of Asphalt Coatings Under Accelerated Test Sidney H. Greenfeld, Bureau of Standards.

Three asphalts, representative of the major sources of coating asphalt used in the manufacture of prepared roofings in the United States, were exposed, without stabilizer and with 30 per cent and 60 per cent of two mineral stabilizers, to accelerated durability tests. Four panels of each coating were subjected daily to 21 hr of exposure to the radiation from an enclosed, low-intensity carbon arc, with the introduction of a chilled water spray (40 F) for 3 min every 20 min (17-3 cycle). Two of the four panels with each coating were also exposed to air at −5 F for 2 hr daily. The use of the 40 F water produced results equivalent to those obtained when both the 40 F water and exposure to air at −5 F were employed.

Wednesday, July 1 11:30 a.m. Twenty-second Session

Report Session

Report of D-16 on Industrial Aromatic Hydrocarbons and Related Materials. D. F. Gould, Chairman.

Report of D-19 on Industrial Water. Max Hecht, Chairman.

Report of E-8 on Nomenclature and Definitions. P. V. Faragher, Chairman.

Report of E-11 on Quality Control of Materials. H. F. Dodge, Chairman.

Report of E-12 on Appearance. M. Rea Paul, Chairman.

Report of E-13 on Absorption Spectroscopy. E. J. Rosenbaum, Chairman.

Report of E-14 on Mass Spectrometry. W. S. Young, Chairman.

Wednesday, July 1 2:00 p.m. Twenty-third Session

Held simultaneously with the Twenty-fourth Session

Symposium on Lateral Pile Load Tests *(Continued)*

Lateral Load Tests on Piles for Design Information. A. A. Wagner, Bureau of Reclamation.

This paper presents the results of lateral load tests of timber piles conducted by the Bureau of Reclamation for design purposes. It summarizes testing experiences, including available foundation information, pile and pile-driving data, vertical load test summary, and results of the lateral load tests. The results of tests performed in four different areas are presented: Loess soil in Nebraska, saturated sand and silt in the Delta area of the Sacramento and San Joaquin Rivers in California, stiff clay and silt in Arizona, and glacial till in Alaska. Because of the limited number of tests, nine in all, and the lack of detail data in most cases, the theoretical aspects of the problem are not considered. However, broad general conclusions and recommendations are given.

The Resistance to Lateral Loading of Single Piles and of Pile Groups. G. P. Tschebotarioff, Princeton University.

The results of model tests on single piles and on three-pile and seven-pile dolphins show that the resistance per pile to lateral loads decreases appreciably with an increasing number of piles in a group.

The location of a pile within a group affects materially the magnitude and the nature of stresses to which it is subjected; considerable bending stresses are engendered in piles at the outer boundary of the group. Conventional procedures of structural analysis which ignore such interaction between the soil and the individual piles of a laterally loaded pile group should be revised.

The Lateral Load Capacity of Timber Pile Groups. J. O'Halloran, Anglo-Canadian Pulp and Paper Mills, Ltd.

Tests on groups of timber piles were conducted in 1927 in connection with the construction of a large newsprint mill on the north bank of the estuary of the St. Charles River in Quebec City. The pile groups were needed for restraining movement of a timber crib structure. Eight spruce piles were driven in two groups, each of which was capped with concrete. Lateral load was applied by means of hydraulic jacks between the groups and records were taken of the deflection throughout the course of five days. Careful records were made, and the paper presents these in summary form.

Wednesday, July 1 2:00 p.m. Twenty-fourth Session

Held simultaneously with the Twenty-third Session

Concrete

Some Effects of the Grading of Sand on Masonry Mortar. C. C. Connor, New Jersey Bell Telephone Co.

The influence of 22 masonry sands on the workability of high-lime mortars containing plastic lime, and upon the cracking between brick and mortar that occurred at existing buildings, is described. A relationship was found between the grading of the sand and workability. The same relationship existed between the sand grading and the mortar joint cracking, except that too much fine material caused the cracking to increase. The present standard grading requirements would have rejected four good sands, and passed one that was unsatisfactory. New grading requirements for masonry sands are suggested which, in limited field use, have consistently given good results.

Thermal Expansion Tests on Aggregates, Neat Cements and Concretes. Leonard J. Mitchell, Bureau of Reclamation.

This paper discusses coefficient of thermal expansion tests on aggregates, neat cement, and concrete. Tests were made on 48 aggregate minerals, 32 neat cements, 14 mortars, and 41 concretes. Controlled variables include cement fineness, water–cement ratio, air content, and moisture content. Moisture content is the most important variable for neat cements causing variations of 100 per cent in the coefficients. Concretes above critical saturation may expand 0.1 per cent during a single freezing.

Equipment for precision tests on easily prepared small specimens is described. Samples as small as 1 in. in size may be quickly and accurately tested.

Prediction of Concrete Durability from Thermal Tests of Aggregate. Elmo C. Higginson and Donald G. Kretsinger, Bureau of Reclamation.

This paper reports the correlation of thermal measurements made on aggregate and concrete with freezing and thawing, wetting and drying, and other simulated weathering tests made at the Bureau of Reclamation laboratories. Data are presented on the effect of differences in thermal properties of the coarse aggregate, sand, and cementing paste on durability of the concrete, and conclusions are made on the importance of thermal properties in producing deterioration in concretes. The possibility of predicting durability of concrete from data obtained in this test is discussed.

Determination of Compressive Strength of Concrete by Using Sonic Properties. Clyde E. Kesler, University of Illinois, and Yoshiro Higuchi, Japanese Imperial Railroad.

A brief discussion is presented explaining why the use of the modulus of elasticity alone is not sufficient to predict the strength of concrete. It is also pointed out and briefly explained that the logarithmic decrement may prove useful in predicting the strength of concrete. Some 300 standard 6 by 12 in. cylinders were tested. A set of curves is presented from which the strength of concrete, when made of the aggregates used in this investigation, can be predicted. The strength can generally be predicted within an accuracy of about five per cent. This accuracy can be obtained without knowledge of the age, mix, or moisture content of the concrete.

Resonant Frequency and Velocity Tests on Concretes Subjected to Freezing and Thawing. G. M. Batchelder, New Hampshire Department of Public Works & Highways, and D. W. Lewis, Purdue University.

The results of resonant frequency and velocity tests on concrete mixes subjected to freezing and thawing are compared and discussed. Dynamic determinations of Poisson's ratio were made on some mixes, and the moduli of elasticity from velocity were calculated.

The tests indicate decreases in Poisson's ratio with deterioration of the concrete. No advantage was found in calculating modulus of elasticity from velocity; change in the velocity squared was a better measure of deterioration. Resonant frequency measurements were more sensitive than velocity tests in detecting damage from freezing and thawing.

An Investigation of Asphaltic Pavement Design Methods. B. A. Vallerga, University of California, and Ernest Zube, California Division of Highways.

Methods currently advocated for the design of asphaltic paving mixtures generally incorporate some type of test to evaluate the property of stability. Also, an integral part of each test method is the specified method of preparing and compacting test specimens. In this investigation comparisons of design methods, stability test methods, and compaction methods are made using an asphaltic paving mixture with a known performance record. This paving mixture consists of dense-graded decomposed granite and ROMC-5 liquid grade asphalt and was used in 1936 to construct an asphaltic pavement in California which has been subjected to heavy traffic without any signs of distress. Because of the low-viscosity characteristics of the asphalt, test methods which are greatly influenced by the consistency of the binder give low stability values inconsistent with performance. Some conclusions are drawn as to the validity of various design methods, particularly with respect to methods of preparing test specimens and of evaluating stability.

Report of Committee C-7 on Lime. J. A. Murray, Chairman.

Report of Committee C-9 on Concrete and Concrete Aggregates. L. W. Teller, Chairman.

Sanford E. Thompson Award.

Report of Committee C-11 on Gypsum. L. S. Wells, Chairman.

Report of Committee C-12 on Mortars for Unit Masonry. J. M. Hardesty, Chairman.

Report of Committee D-1 on Paint, Varnish, Lacquer, and Related Products. W. T. Pearce, Chairman.

Report of Committee D-6 on Paper and Paper Products. W. R. Willets, Chairman.

Report of Committee D-8 on Bituminous Waterproofing and Roofing Materials. H. R. Snoke, Chairman.

Wednesday, July 1 4:30 p.m. Twenty-fifth Session

Marburg Lecture, Dudley Medal, and Awards

Marburg Lecture—An Excursion in Petroleum Chemistry. Frederick D. Rossini, Head, Department of Chemistry, and Director API Research Laboratory, Carnegie Institute of Technology.

The purpose of the Edgar Marburg Lecture is to have described at the annual meetings of the Society, by leaders in their respective fields, outstanding developments in the promotion of knowledge of engineering materials. Established as a means of emphasizing the importance of the function of the Society of promoting knowledge of materials, the Lecture honors and perpetuates the memory of Edgar Marburg, first Secretary of the Society, who placed its work on a firm foundation and through his development of the technical programs brought wide recognition to the Society as a forum for the discussion of properties and tests of engineering materials.

Charles B. Dudley Medal

Richard L. Templin Award

Sam Tour Award

Wednesday, July 1

Cocktail Party 6:30 p.m.
and
Annual Meeting Dinner 7:30 p.m.

Thursday, July 2 9:00 a.m. Twenty-sixth Session

Symposium on Porcelain Enamels and Ceramic Coatings as Engineering Materials

Report of Committee C-22 on Porcelain Enamels. W. N. Harrison, Chairman.

Symposium on Porcelain Enamels

Introduction. Dwight G. Bennett, University of Illinois.

This symposium has been set up as a carefully planned and thorough effort to make "working engineers" better acquainted with the very useful and available subject materials.

In the program itself, due attention has been given to a number of important but diversified fields to which such coatings are particularly adapted. These fields cover areas wherein an attractive and easily maintained surface is desired or where metal is subject to deterioration by such things as heat, abrasion, vibration, or close contact with corrosive liquids and gases of many kinds.

It is quite possible that some of the greatest financial savings to be gained by use of ceramic coatings will be made in areas where ordinary uncoated steel is used at moderately high temperatures and has heretofore been frequently replaced as a matter of course.

Some Examples of the Functional Use of Glass as a Coating for Steel. G. H. Spencer-Strong, Pemco Corp.

Porcelain enamels are fundamentally very superior protective coatings. Because they combine protection with a highly decorative finish, their protective properties are often overlooked by the general public. The facts are, however, that even with end uses calling for a highly decorative finish, the choice of porcelain enamels is largely based on their superior protective qualities. The present discussion describes the utilization of porcelain enamel coatings in many types of services and deals with the engineering properties of the coatings which have made these uses successful. Such end uses range from architectural and home appliance applications to conveyor equipment, chemical plant equipment, machinery parts, and high-temperature applications.

Resistance of Porcelain Enamels to Weathering. Dwight G. Moore, National Bureau of Standards.

A study of the weather resistance of porcelain enamels has been under way at the National Bureau of Standards since 1939. A total of 864 one-ft square panels are being exposed at four locations selected to represent temperate residential, temperate industrial, temperate salt air, and semitropical residential. The results so far obtained show that most enamels are highly resistant to deterioration under the conditions existing at the selected locations and further that those enamels that are not resistant can be rejected prior to installation by simple laboratory tests.

The results obtained from an inspection made after seven years of exposure are given.

The Chemical Resistance of Glassed-Steel Process Equipment. O. J. Britton and E. A. Sanford, The Pfaudler Co.

Actual results of tests on chemical resistance of glassed steel as used for process equipment are reported in this paper. Included are data on some common acids at temperatures above 212 F. Specific instances where glassed steel is being used in severe services are cited. Test methods and equipment for both laboratory and field tests are described.

Acid Resisting Properties of Porcelain Enamels. Harold C. Wilson, Vitreous Steel Products Co.

Various general types of acid exposure conditions are outlined with the service requirements for each, including chemical processing, food industries, and architectural applications. The comparative resistance of numerous types of porcelain enamel to acid attack is briefly surveyed. The effect of various types of acids on porcelain enamel is noted with comments on the importance of temperature and concentrations. Prospective users of porcelain enamel coatings for acid resisting services are advised to consult a qualified ceramic engineer in selecting the proper type of coating.

Analysis of the Expected Benefits Resulting from the Application of Coatings to High Temperature Components of a Jet Engine. Allen C. Francisco, NACA-Lewis Flight Propulsion Lab.

The continued improvement of aircraft propulsion systems is based on increased temperatures since the efficiency of the turboprop depends on gas temperature at the turbine and the maximum thrust of a turbojet increases with higher temperatures. The components of a jet engine that might be benefited by coatings are discussed in the light of current materials and operating conditions. These include combustion can shells and liners, stator and rotating blades of cooled and uncooled designs, turbine disks, tailcones, and afterburners for turbo-engines, flameholders for ramjets, and nozzles for rockets.

The mechanism by which coatings can achieve improvements is described. Corrosion protection is afforded materials subject to oxidation or intergranular corrosion from fuels and combustion products. Substitution of coated nonstrategic alloys may depend on the combined properties of corrosion resistance, increased structural stiffness of coated metal, and lower and more uniform metal temperature due to the lower thermal conductivity of the coating materials. The importance of radiation suppression as a field for future development is indicated.

High Temperature Ceramic Coatings as Applied to Aircraft Power Plants. B. L. Paris, Wright Air Development Center.

A summary of the expected benefits to be

derived from the use of the high-temperature ceramic coatings by both industry and the Armed Services will be presented. In general, these benefits can be subdivided into two classifications, the first being the use of such coatings to extend the life of relatively high alloys in such applications as reciprocating engine exhaust systems, and high-temperature furnace components where failure is generally a result of oxidation, corrosion, and embrittlement; and secondly, the coating of low-alloy steels to replace the critical and expensive alloys currently being used in the hot gas sections of gas turbine power plants. The properties of these coatings and the position of the industrial engineer relative to this over-all high-temperature coating program are also presented.

The Industrial Processing of High Temperature Ceramic Coatings. J. H. Terry, Hotpoint Inc.

The production of aircraft components with ceramic coatings for high-temperature corrosion protection is discussed. The types of equipment of special design required for processing of these coatings are described. Details are given of the procedures used in metal and coating preparation, application, drying, and firing of the heat-resistant finish to aircraft parts. The use of various coatings on alloys ranging from mild steel to stainless steel, and variations in techniques are described. Methods are outlined for laboratory evaluation and process control.

(Continued in the Twenty-eighth Session)

Thursday, July 2 1:30 p.m. Twenty-seventh Session

Held simultaneously with the Twenty-eighth and Twenty-ninth Sessions

Plastics

Report of Committee D-20 on Plastics. R. K. Witt, Chairman.

Report of Committee D-9 on Electrical Insulating Materials. A. H. Scott, Chairman.

Determination of Elastic Constants of Orthotropic Materials with Special Reference to Laminates. R. K. Witt, W. H. Hoppmann II, and R. S. Buxbaum, The Johns Hopkins University.

This paper deals with the theoretical basis and an experimental method for the determination of elastic constants for orthotropic materials by measuring deflections of a thin plate subject to couples on its boundary. Constants were determined for glass melamine, glass silicone, and paper-base phenolic laminates.

Three Years Outdoor Weather Aging of Plastics Under Various Climatological Conditions. S. E. Yustein and R. R. Winans, New York Naval Shipyard, and H. J. Stark, Bureau of Ships.

The effects of outdoor weather aging under widely different climates are investigated for various types of plastics. Five climatological regions are represented in the program which provides for outdoor exposures in tropical, desert, temperate, subarctic, and arctic climate. Various exposure periods from 1 to 36 months were employed, and various mechanical, electrical, and optical properties were evaluated. On the basis of the extensive data accumulated, it is possible to deduce the occurrence of a variety of effects that appear to be related to differences in climatic and environmental conditions.

Thursday, July 2 2:30 p.m. Twenty-eighth Session

Held simultaneously with the Twenty-seventh and Twenty-ninth Sessions

Symposium on Porcelain Enamels and Ceramic Coatings as Engineering Materials *(Continued)*

A Study of the Abrasion Resistance of Various Types of Porcelain Enamel. A. V. Sharon, Chicago Vitreous Enamel Product Co.

Abrasion resistance tests of various types of porcelain enamel were made using the Taber Abraser. Photomicrographs are given of Faxfilm replicas of the abraded enamel surfaces. A nonacid-resisting antimony enamel with the least wear resistance showed a weight loss almost twice that of the ground coat, the acid-resisting antimony, or the zirconium enamels. The weight loss of the last three enamels was approximately five to six times that of the titanium opacified enamels.

The Resistance of Porcelain Enamels to Surface Abrasion as Determined by the PEI Test. John T. Roberts, Crane Co.

One of the most important properties of a porcelain enamel is its ability to resist abrasion. Generally speaking there are three types of abrasion, namely, (1) abrasion from freely moving particles, (2) abrasion from particles applied under load using a soft applicator, and (3) abrasion from particles applied under load using a hard applicator. A method of test for surface abrasion is described and some test data are presented showing the effect of SiO_2 content in an enamel, hardness of an abrasive particle, and fineness of a particle on the severity of abrasion. A porcelain enamel by virtue of its degree of hardness and its response to the surface abrasion test should satisfactorily withstand the abrasive action of any type of material which is allowed to flow freely over its surface or flows over its surface under the pressure of a soft object.

Torsion Testing as an Aid to the Porcelain Enamel Industry. Earl Hoover, Westinghouse Electric Corp.

The history and development of torsion testing as applied to porcelain enamel products are briefly discussed and illustrated, showing its application as a measuring medium, for enamel process control, development studies, incoming material evaluation, and the monitoring of packaging costs. The torsion test simulates enamel stresses in transit where an estimated 98 per cent of all enamel failures occur.

The Strengthening Effect of Porcelain Enamel on Sheet Iron as Indicated by Bending Tests. E. E. Bryant, Ferro Corp.

Load *versus* deflection curves for bending of flat porcelain enamel samples indicates the following: Porcelain enamel will produce a definite stiffening effect. There is very little increase in resistance to pure tensile stress when iron is coated with enamel. Deflection prior to exceeding the yield point may be reduced when iron is porcelain enameled, but resistance to deflection is increased. Enamels in greater compression (low-expansion enamels) produce the greater stiffening effect.

Tension Tests of Porcelain Enameled Steels. W. A. Deringer, A. O. Smith Corp.

Tension tests of a number of porcelain enamel steel specimens were made. Two different steel compositions and three different porcelain enamel compositions were the variables investigated. A Phillips extensometer and a Baldwin Southwark stress-strain recorder were used in obtaining the stress-strain curves. The results, interpretation of results, and the difficulties and limitations encountered in this investigation, are discussed.

The Effect of Temperature on the Electrical Resistivity of Several Silicone and Ceramic-Type Coatings. Simon W. Strauss, Lloyd E. Richards, and D. G. Moore, National Bureau of Standards.

The electrical resistivity of sheet mica, a ground coat porcelain enamel, two alkali-free ceramic coatings, a silicone varnish, and a coating consisting of a silicone varnish mixed with ground mica, were measured in the temperature region 100 to 500 C and at an applied direct current potential of 200 v. A plot of the logarithm of the resistivity *versus* the reciprocal of the absolute temperature for each of these materials showed that marked deviations from the Rasch-Hinrichsen law occurred only with silicone and silicone-mica coatings. The electrical resistivity of all coatings tested was found to be independent of coating thickness and to prolonged aging at 200 C. The measured resistivities in ohm centimeters of the materials when tested at 400 C were: (*a*) silicone-mica coating, 1.4×10^{11}, (*b*) mica, 3.2×10^{10}, (*c*) silicone varnish coating, 2.8×10^{10}, (*d*) alkali-free ceramic coating, 1.6×10^{9}, (*e*) ground coat enamel, 2.5×10^{8}.

A Laboratory Evaluation of Ceramic Coatings for High Temperature Applications. Sara J. Ketcham, Naval Air Material Center.

An investigation is being conducted to evaluate available ceramic coatings for the protection of 321 stainless steel from oxidation and thermal shock at temperatures up to 1800 F, and 4130 steel at temperatures up to 1200 F. Test methods are described with emphasis on the thermal shock testing equipment and on the value of microscopic studies for determining the relative merits of the various coatings. All of the coatings tested improve to some extent the oxidation resistance of both 321 stainless steel and 4130 steel, with the exception of two, whose effects on the base metals were decidedly deleterious.

In Retrospect and in Prospect—Summary. W. N. Harrison, National Bureau of Standards.

Thursday, July 2 2:30 p.m. Twenty-ninth Session

Held simultaneously with the Twenty-seventh and Twenty-eighth Sessions

Symposium on Dynamic Testing of Soils

Introduction. R. K. Bernhard, Rutgers University.

The purpose of this Symposium is twofold: first, to assemble available information, and second, to discuss as yet unsolved problems in soil dynamics.

From the practicing engineer's point of view the impetus to study these problems is due mainly to increased speeds and loads of our vehicles affecting highway subsoils and also to the practical application of precompaction of subsoils by means of dynamic methods.

From the more theoretical point of view the determination of basic dynamic soil values, such as moduli of elasticity, damping, spring characteristic, energy dissipation, resonance phenomena, etc., are of fundamental importance.

Both points of view lead to one of the predominant and rather difficult questions: can we develop a mathematical model or dynamic analogy which will permit the prediction of the behavior of soils subjected to vibratory loads?

With these thoughts in mind the subcommittee asked the authors for contributions to this symposium, as the first approach toward a solution of some of the above questions.

Elasticity and Damping of Oscillating Bodies on the Soil. Ing. H. Lorenz, Technische Universität, Berlin.

For several years tests have been performed with a vibrator acting on the soil dynamically with pure sinoidal forces. These experiments have shown that the reactive forces of the soil follow nonlinear laws contrary to a supposition for harmonic vibrations. Graphical methods are suggested to eliminate mathematical difficulties which arise when solving for nonlinear reactive forces. These methods have been adapted to the special condition in soil dynamics, particularly to evaluate experimentally obtained resonance curves. A typical curve is discussed which describes dynamic properties of the soil better than previously used so-called "bedding values." Furthermore, the paper presents an analytical method for determining the dynamic soil characteristics. Finally, it is shown that with values derived from the soil characteristics, the dynamic behavior of machine foundations can be calculated.

The Pressures Generated in Soil by Compacting Equipment. A. C. Whiffin, Road Research Laboratory, England.

Piezoelectric quartz pressure gages were used to measure the dynamic stresses generated in soil by compacting plant including a smooth wheel roller, a tractor, and two types of power rammer. Vibrating wire pressure gages were also used in some of the tests with slower machines. During compaction, the peak pressure at a given initial depth increased with the number of passes of the plant until it attained a limiting value which was related to the limiting value of the soil density attained at that depth and which decreased rapidly with depth. Tests on silty clay at a moisture content of 15 to 16 per cent showed that the relation between density and pressure was independent of the type of compacting plant, that is, it did not depend on the duration of the impulse generated by the machines which ranged from 20 to 25 milliseconds for the rammers, to 2 to 5 sec for the roller and tractor. It appears that roller compacting machines might well be operated at higher speeds than those at present commonly used.

Loose Sands—Their Compaction by Vibroflotation. Elio D'Appolonia, Carnegie Institute of Technology.

Normally loose granular deposits have adequate bearing capacity for foundation loads that are applied statically. However, under vibratory loads the loose deposits are gradually, and sometimes suddenly, changed into a dense state. The settlements that result are often destructive and costly. Vibroflotation is a simple, effective process that can be used to compact loose granular soils prior to construction. Field data presented show the effectiveness of the process. Test procedures for minimum and maximum dry unit weights needed for relative density, which is used as a criterion for compaction, are discussed.

(Continued in Thirtieth Session)

Performance Records of Engine Foundations. Gregory P. Tschebotarioff, Princeton University.

Data on the performance of full scale foundations of structures under static loading have permitted the correction of many soil testing techniques and procedures of analysis. The need for similar full scale data concerning the effect of dynamic loads on engine foundations is equally great, but little has been published.

The difficulties presented by the problem of obtaining relevant and reliable information on the resonance characteristics of engine foundations are reviewed; the scant data obtained so far are tabulated and analyzed; proposals are advanced, as a basis for discussion, concerning the information needed and the manner of recording it.

Makromeritic Liquids. Hans F. Winterkorn, Princeton University.

The observed liquefaction of assemblies of makro-particles, such as sand and gravel deposits, as a result of earthquake and explosion shock; the liquefaction of lean concrete mixtures by vibration; and the use of vibration for densification of granular systems are of sufficient economic, scientific; and engineering interest to warrant examination of these phenomena from a fundamental point of view. This paper represents a first step in the analysis of what makes makro-particle systems actual and potential liquids. Despite the simplicity and preliminary character of this first step it already permits the drawing of important conclusions with respect to the design and bearing power of certain granular systems and to their densification by vibration.

Pilot Studies on Soil Dynamics. R. K. Bernhard, Rutgers University, and J. Finelli, Stevens Institute of Technology.

A few fundamental questions in the field of Soil Dynamics are investigated. Four topics are discussed: (1) Density and Compaction, (2) Propagation Velocity and Moduli of Elasticity, (3) Viscosity Damping and Shear, and (4) Response Curves and Critical Frequencies.

Theoretical data and experimental results based on pilot tests, emanating to a certain extent from an "applied research" project, have been collected and compared with results of other investigators, with the main objective to probe some possible angles of approach.

Thursday, July 2 8:00 p.m. Thirtieth Session

Held simultaneously with the Thirty-first Session

Symposium on Dynamic Testing of Soils *(Continued)*

Compaction of Sand at Resonant Frequency. F. J. Converse, California Institute of Technology.

This paper discusses the effect on the density of soil of operating a surface vibrator at the resonant frequency of the vibrator-soil system. Observed effects on sand and sandy loam are discussed and possible explanations of behavior are suggested.

The Elastic Theory of Soil Dynamics. Patrick M. Quinlan, University College, Cork, Ireland.

This paper is a counterpart to Bousinesque's equations that have so many successful applications in the soil mechanics of a medium at rest. In the main it is a simplification to the case of an isotropic medium of "Vibrations in an Aeolotropic Medium," a theoretical contribution by the author to a project on "Compaction of Soil by Vibration" at the California Institute of Technology, 1948–1949. Solutions are obtained for the circular and the long rectangular vibrator under various assumptions as to contact pressure. Reissner (1936) deals with the case of a circular vibrator when the contact pressure is assumed to be uniform; the present approach is easier to comprehend, and it also succeeds in replacing Reissner's Principal Value Integrals by Definite Integrals. Apart from this case the results obtained in this paper are made available for the first time. Finally predictions based on the above theory when compared with experimental results show a fair measure of agreement.

A Dynamic Analogy for Foundation-Soil Systems. Adrian Pauw, University of Missouri.

The problems involved in the design of machine foundations are briefly discussed. An analogy is presented which permits the determination of the dynamic soil constants required for predicting the natural frequencies of a foundation-soil system. Analytical

expressions are derived for the equivalent spring factors and apparent mass terms of the analogous system, and results are presented in graphical form to permit rapid calculation. The equations of motion for a block foundation are discussed and sample calculations for determining the natural frequencies of a typical foundation are shown.

A Discontinuous Model for the Problems of Soil Dynamics. J. J. Slade, Jr., Rutgers University.

Vibrations on the surface of the earth that are observed at a distance from the source of disturbance are adequately described through the use of an elastic model of the soil. Near the disturbing source, however, certain effects have been observed that do not seem to be reconcilable with the assumption of elasticity. An attempt is made to introduce a coupling region between the source and the outer region of the medium. The anomalous effects are then considered as coupling phenomena.

Vibration Research on Road Construction. C. van der Poel, Koninklijke/Shell-Laboratorium (Royal Dutch/Shell Group).

The present paper discusses the results of dynamical loading experiments on roads, using a machine which exerts sinusoidally alternating forces on the pavement. Experiments with such a machine supply information of three different types. First, one can measure the rate of propagation of the waves produced by the machine. Results of these measurements have already been published and some fresh data will be given here. However, in this paper special attention will be given to the interpretation of these data. The results will be compared with those of German (H. Lorenz) and Swedish investigators and similarities and differences will be discussed. Second, one can measure the deformation of the road under the machine, which gives an idea of the over-all stiffness of the road structure. Third, the strains produced in the carpet can be measured. In this connection particular attention will be given to the difficulty of imitating actual conditions under the wheel-tire, because this requires knowledge of the force acting on the pavement.

Some remarks will be made on the frequent occurrence of strong nonlinear effects. Extrapolation not being possible, this compels the use of alternating forces of the same magnitude as those generated by traffic. Theoretical considerations also become extremely difficult in this connection. Finally, results are given of measurements under actual traffic and they are compared with those obtained with the above-mentioned machine.

Vibrations in Semi-Infinite Solids Due to Periodic Surface Loading. Tse Yung Sung, Harvard University.

An additional variable, which was not treated in previous analysis by E. Reissner, arising from a change in pressure distribution at the oscillator base is considered. Axial symmetrically distributed pressure at the surface of a semi-infinite solid is assumed to be uniform, parabolic, and produced by a rigid base. The analytical solution from this paper with suitable tests made it possible to predict the critical frequency, amplitude of oscillation, and power requirement for a wide range of oscillator-foundation combinations.

Thursday, July 2 8:00 p.m. Thirty-first Session

Held simultaneously with the Thirtieth Session

Corrosion

Report of Committee A-5 on Corrosion of Iron and Steel. A. P. Jahn, Chairman

Appendix:

Some Observations on the Preece Test and Stripping Tests for Zinc Coating Wires. G. A. Ellinger, T. H. Orem, and W. J. Pauli, National Bureau of Standards.

A report on an investigation of the Preece Test published in 1934 by Groesbeck and Walkup concluded that the rates of solution of variously applied galvanized coatings on steel wires varied in accordance with the type of coating and that, therefore, the test could not be considered a means of determining or indicating the coating thickness on the wire, although it is an acceptable means of ascertaining the uniformity of coating. Based on the above and following further recommendations of these investigators regarding certain precautions to be observed in the conducting of the test, a recent more searching evaluation of the Preece Test has confirmed the above observation relative to the variation in solution rates of galvanized coatings obtained by different coating methods. Thirteen variously coated wires from 8 manufacturers, 2 of which were electrogalvanized, 4 regularly galvanized, 3 asbestos wiped, and 4 galvannealed, and in addition wires drawn from electrolytic and Prime Western zinc, were investigated. Weight losses were measured after each dip of one minute or fractional part of a minute for each wire, and the results showed consistently that the coatings on the galvannealed wires dissolved at the slowest rate, those on the asbestos-wiped wires at a slightly faster rate, and those on the electrogalvanized and regularly galvanized wires at the fastest rates.

The weight of coatings on the various wires was determined by the Hydrochloric Acid-Antimony Chloride and Sulfuric Acid Methods recommended in ASTM Methods of Test for Weight of Coating on Zinc Coated (Galvanized) Iron or Steel Articles (A 90 – 39) and in addition by means of a 50:50 hydrochloric acid-water solution. Stripping was also conducted in accordance with an electrolytic method which in addition to giving results comparable to those obtained by chemical stripping, provided valuable information regarding the processes by which the wire was coated and the relative proportions of alloy layer and pure zinc.

Report of Committee A-9 on Ferro-Alloys. W. C. Bowden, Jr., Chairman.

Report of Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel, and Related Alloys. Jerome Strauss, Chairman.

Report of Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys. K. G. Compton, Chairman.

Appendix

Corrosiveness of Various Atmospheric Test Sites as Measured by Specimens of Steel and of Zinc. C. P. Larrabee, United States Steel Co., and O. B. Ellis, Armco Steel Corp.

Data, resulting from exposure of specimens of steel and of zinc to the atmosphere at seven test sites, are discussed with reference to variations caused by exposure in four successive years. At each of five locations, the successive yearly losses are in agreement. At the two industrial sites large variations in yearly losses of steel are found. Large differences between losses of specimens exposed in the spring and in the fall at one site are discussed.

The Corrosion of Beryllium Copper Strip in Sea Water and Marine Atmospheres. J. T. Richards, The Beryllium Corp.

Results are reported for corrosion tests on beryllium copper and beryllium-cobalt-copper conducted over the past several years at Harbor Island and Kure Beach, N. C. As a means of evaluation, strip specimens were exposed to quiet and flowing sea water, rotation through the water at high velocity, jet impingement, and galvanic action. Specimens were also submitted to marine atmosphere at 80 and 800 ft from the sea. In addition, the effects of time, velocity, temper, heat treatment, and edge condition were investigated. Comparison materials included phosphorus deoxidized copper, arsenical admiralty, iron-modified 70-30 cupro-nickel and phosphor bronze grade A.

Report of Committee B-6 on Die-Cast Metals and Alloys. W. Babington, Chairman.

Report of Committee B-7 on Light Metals and Alloys, Cast and Wrought. I. V. Williams, Chairman.

Report of Committee E-1 on Methods of Testing. J. R. Townsend, Chairman.

Report of Committee E-7 on Non-Destructive Testing. J. H. Bly, Chairman.

Friday, July 3 9:00 a.m. Thirty-second Session

Steel (*Continued*)

Tension Impact Testing of Sheet Metals. Carl W. Muhlenbruch, Northwestern University.

Applications of stainless steel and low-alloy steel materials to aircraft, railroad, and transport vehicles have led to a need for knowledge of the fracture toughness of these materials in sheet form, as obtained from the tension impact test.

Tests specimens and fittings have been developed, for use in several makes of impact machines, to determine the impact strength of sheet metals up to 0.125 in. thick. The method of machining the fittings and specimens as well as permissible tolerances for satisfactory test results are reported. Two types of fittings and test specimens are described, one for the determination of basic fracture toughness values and the other for an evaluation of notch sensitivity. The specimens have reduced center test section 0.20 in. wide. Generous fillets provide transition to the shouldered end shanks which are held in split grips. The energy of the blow is thus transmitted from the grips to the reduced center section of the specimen through the fillets. The device is readily assembled and disassembled, even at room temperatures as low as −50 F.

A method is presented for obtaining the ultimate static true stress from a true stress *versus* log true strain relationship for the plastic range just before and after the ultimate load. The method is considered to have merit in the correlation of impact test data with static tests.

The Measurement of Directional Strength in Straight- and Cross-Rolled Strip by the Navy Tear Test. Helen Hoover, International Harvester Co.

Hardened and tempered straight and cross rolled 1085 strip steel was studied with the object of measuring directional variations by a method adequate to show behavior differences in relation to rolling direction. The Navy tear test showed directionality and type of rolling, and gave a quantitative strength distribution in numerical values around a hypothetical centerpoint in the strip. Other methods used and briefly discussed are chemical analysis, microexamination, ball test, axial tension test, reverse bending fatigue test, cathodic etching, and magnetometric study. Over-all strength of the two rolling types was similar, but the straight rolled was more directional, strength apparently increasing with rolling effect.

A Comparison of Twenty Impact Testing Machines in the 20–30 Ft-Lb Range. R. L. Rickett, W. B. Seens, R. Roeloffs, R. W. Vanderbeck, United States Steel Corp., and C. Daniel, Engineering Statistician, New York City.

The object of this investigation was to compare the results of impact tests conducted under closely comparable conditions on twenty machines made by four manufacturers. Charpy keyhole-notch specimens were used and the tests were made at 80 F, the resulting impact energy values being in the range 20 to 30 ft-lb.

The maximum difference in the averages of 64 tests on each machine was approximately 4 ft-lb. Most of the machines differed by a considerably smaller amount than this. The order of the machines (as established by their respective average energy values) was found to differ slightly in testing two different types of steel. Calibration of the machines did not reduce the observed spread in results. A few testing variables were investigated to a limited extent but did not reveal the cause of the observed differences among machines.

Delayed Yielding in Annealed Low-Carbon Steel Under Compression Impact. J. E. Johnson, Rohm and Haas, D. S. Wood and D. S. Clark, California Institute of Technology.

The delay time for the initiation of yielding in an annealed low-carbon steel is investigated experimentally under longitudinal compression impact. Delay times in the range from 40 microsec to 1.5 millisec are determined as a function of the initial impact stress at temperatures of 73, 150, and 250 F. The stress *versus* delay time relation at 73 F is found to be in good agreement with an extrapolation from previous data at longer delay times and lower stresses obtained by rapid-load tension tests on the same material. The initiation of yielding is found to be accompanied by a decrease in stress, the magnitude of which does not vary systematically with the initial impact stress.

Report of Committee A-1 on Steel. N. L. Mochel, Chairman.

Friday, July 3 11:30 a.m. Thirty-third Session

Held simultaneously with the Thirty-fourth Session

Report Session

Report of Committee D-12 on Soaps and Other Detergents. J. C. Harris, Chairman.

Report of Committee D-13 on Textile Materials. W. D. Appel, Chairman.

Report of Committee D-14 on Adhesives. Gerald Reinsmith, Chairman.

Report of Committee D-15 on Engine Antifreezes. H. R. Wolf, Chairman.

Report of Committee D-2 on Petroleum Products and Lubricants. O. L. Maag, Chairman.

Report of Committee D-4 on Road and Paving Materials. C. A. Carpenter, Chairman.

Report of Committee D-11 on Rubber and Rubber-Like Materials. Simon Collier, Chairman.

Report of Committee D-17 on Naval Stores. V. E. Grotlisch, Chairman.

Report of Committee D-18 on Soils for Engineering Purposes. E. J. Kilcawley, Chairman.

Friday, July 3 11:30 a.m. Thirty-fourth Session

Held simultaneously with the Thirty-third Session

Report Session

Report of Committee C-2 on Magnesium Oxychloride and Magnesium Oxysulfate Cements. L. S. Wells, Chairman.

Report of Committee C-8 on Refractories. R. B. Sosman, Chairman.

Report of Committee C-15 on Manufactured Masonry Units. J. W. Whittemore, Chairman.

Report of Committee C-16 on Thermal Insulating Materials. E. R. Queer, Chairman.

Report of Committee C-17 on Asbestos-Cement Products. D. Wolochow, Chairman.

Report of Committee C-18 on Natural Building Stones. L. W. Currier, Chairman.

Report of Committee C-19 on Structural Sandwich Constructions. E. W. Kuenzi, Chairman.

Report of Committee C-20 on Acoustical Materials. H. A. Leedy, Chairman.

Report of Committee C-21 on Ceramic Whiteware. C. G. Harman, Chairman.

Report of Committee E-5 on Fire Tests of Materials and Construction. A. L. Brown, Chairman.

Report of Committee E-6 on Methods of Testing Building Constructions. J. A. Liska, Chairman.

Report of Committee C-1 on Cement. R. R. Litehiser, Chairman.

New Standards Actions on Shipping Containers and Electrical Alloys

Shipping Containers

A Tentative Method of Test for Water Vapor Permeability of Packages by Cycle Method (D 1251 – 53 T), submitted by Committee D-10 on Shipping Containers, was approved April 16, 1953 by the Administrative Committee on Standards.

This method was developed by the committee in response to a need for a test procedure to measure the performance of a package with respect to water vapor permeability when exposed to a cycle of 0 to 100 F at a relative humidity of 90 per cent. This method differs from the existing standard D 895 which measures water vapor permeability at the fixed condition of 100 F and relative humidity of 90 per cent.

The new method applies to finished packages when closed and sealed in a conventional manner and is intended for "shelf size" packages which are shipped on outside containers.

Electrical Alloys

The Standards Committee also approved, on April 16, 1953, a revision of Tentative Specifications for Round Chromium-Copper Wire for Electronic Devices (B 268 – 52 T) submitted by Committee B-4 on Electrical Heating, Resistance and Related Alloys. In this revision chromium limits are returned to their original value, having been the subject of a previous change to narrower limits. In addition, the tolerances on the diameter of the wire were broadened to represent plus and minus 10 per cent of the maximum size and range.

Technical Papers Published

IT IS planned to include in each issue of the ASTM BULLETIN a list of the technical papers which have recently appeared.

These lists largely comprise papers contained in the newer Special Technical Publications although some of them are advance printing of individual papers that are to appear in the *Proceedings*.

Symposium on Strength and Ductility of Metals at Elevated Temperatures

A Survey of Embrittlement and Notch Sensitivity of Heat Resisting Steels—G. Sachs and W. F. Brown, Jr.

Effect of a Notch and of Hardness on the Rupture Strength of Discaloy—F. C. Hull, E. K. Hann, and H. Scott

Influence of Sharp Notches on the Stress-Rupture Characteristics of Several Heat-Resisting Alloys—W. F. Brown, Jr., M. H. Jones, and D. P. Newman

The Effect of Grain Size Upon the Fatigue Properties of 80, 1200, and 1600 F of the "Precision-Cast" Alloy X-40—P. R. Toolin

Investigations Into the Effect of Notches on the Results of Long-Time Rupture Tests at Elevated Temperatures—W. Siegfried

Theory of Time-Dependent Rupture and Interpretation of Some Stress-Rupture Data—D. N. Frey

Effect of Notch Geometry on Rupture Strength at Elevated Temperatures—E. H. Davis and M. J. Manjoine

Notch Rupture Tests of Inconel X and Nimonic 80A—D. E. Furman and A. M. Talbot

An Experimental Study of the Strength and Ductility of Steel at Elevated Temperatures—J. Glen

Effect of Sigma on Strength and Ductility of 25 Cr, 20 Ni Steel—G. V. Smith and E. J. Dulis

Recovery and Creep in an Alloy Steel—H. A. Lequear and J. D. Lubahn

The Structure and Properties of Stainless Steels After Exposure at Elevated Temperatures—A. B. Wilder and E. F. Ketterer

Symposium on Conditioning and Weathering

Fundamentals of Atmospheric Elements—B. C. Haynes

Air Conditioning in the Manufacture and Testing of Textiles—R. H. Brown

Conditioning and Weathering of Paper—William R. Willets

Conditioning and Weathering of Adhesives and Plastics—F. W. Reinhart

Weathering of Some Organic Coatings—E. J. Dunn, Jr.

Weathering Tests on Metallic Coatings—William Blum

Laboratory Air Conditioning—A. E. Stacey, Jr.

Development of a Moisture Resistance Test—C. P. Lascaro

Outdoor Exposure Testing on Racks and Test Fences—K. G. Compton

Accelerated Weathering Devices—R. H. Sawyer

Symposium Discusses Exchange Phenomena in Soils Engineering Performance

RECOGNITION by Committee D-18 on Soils for Engineering Purposes of the significance of physico-chemical properties of soils in relation to engineering uses led to the organization in 1947 of Subcommittee R-6 to carry on work in this field. It was this subcommittee that sponsored the Symposium on Exchange Phenomena in Soils which was held at the ASTM 50th Anniversary Meeting in June, 1952, and has recently been published as *STP No. 142*.

In this symposium, the authors emphasized the influence of molecular and ionic exchange upon properties and responses of soils. This influence is of critical importance to the soils mechanics engineer and to the designer and construction engineer he serves because it determines to a significant degree the engineering performance of soils in foundations, slopes, and embankments. Knowledge of these phenomena gives rise to methods of altering soils to achieve the desired engineering performance under adverse circumstances. These papers also demonstrate the dynamic nature of these phenomena which means that exchange equilibrium is subject to modification by changes incident to construction, or that exchange effected purposefully to achieve stabilization can be undone by natural processes.

Following an Introduction by R. C. Mielenz, these papers appear:

Ion Exchange in Relation to Some Properties of Soil-Water Systems—Ralph E. Grim

Cation Exchange Capacity of Loess and Its Relation to Engineering Properties—Donald T. Davidson and John B. Sheeler

Job Experience with Exchange Phenomena Involving Inorganic and Organic Ions—Hans F. Winterkorn

Surface Chemical Properties of Clay Minerals and Soils from Theoretical and Experimental Developments in Electroosmosis—Hans F. Winterkorn

Some Effects of Treating Expansive Clays with Calcium Hydroxide—Irving Goldberg and Alexander Klein

Summary—Edmund F. Preece

The complete symposium, together with individual discussions, is available in heavy paper cover at a price of $1.75; price to ASTM members is $1.35.

Production of Today's Weapons Seen as Challenge to Standardizing Groups

Metallurgical Progress May Necessitate Revitalizing Standards

More effective use should be made of the traditional approach to standards, especially in the metallurgical field, since anything less is not likely to insure the full use of the findings of government-sponsored researchers, although they represent fully one third of our present research effort. These findings are vital to the best development and production of tomorrow's civilian products as well as today's weapons for national security. Greater active participation of government research workers in the "general-interest group," of standardizing society, working committees, should be sought.

In essence, this was the message contained in an address by W. J. Harris, Jr., Executive Secretary of the National Academy of Science's Mineral and Metals Advisory Board, to members of the ASA Standards Council at their meeting on April 2, 1953, in New York.

Dr. Harris said that he had come before the group, speaking ". . .for the metallurgical research groups of the country who look upon standards as the end products of research." He said that to match our potential enemies' manpower with our technological ingenuity, we are committed to the new mechanical warfare. We must build gas turbines for aircraft use, ramjets, rockets and guided missiles, complex fuzing devices, and accurate radar. He observed that all of these weapons . . . "have posed design concepts. . ." and their resulting materials problems ". . .far beyond. . ." any present civilian counterparts. He voiced an opinion that the requirements of high-performance, reduced weight, and ". . .for destructive purposes. . ." have necessitated new concepts of acceptable strengths of materials.

Dr. Harris pointed out that as a result there has been an increasing support of research by the Government. He said that the 1952 national outlay for research and development has been estimated to total more than $3\frac{1}{2}$ billion dollars. He explained that at least one fourth of this was for work by the Federal Government in its own laboratories and one third was for government-sponsored work in private industry's laboratories. He said that the one fourth performed in government laboratories has not been given sufficient attention by the producer-consumer team which is still responsible for standards.

Dr. Harris, in describing a need for alterations in present standardizing procedures, spoke of ASA and ASTM. "The ASA and its cooperating societies, such as ASTM, incude on their technical working groups, which prepare the basic documents for later policy action, representatives of the producing and consuming industries, and also a group stated to be 'the general interest group,'" he noted. He added that the bulk of research until 1941 or 1942 had been performed in consumers' and producers' laboratories and that its results had been transferred directly to the working standards committees.

Dr. Harris said that many of these committees of the various societies ". . .devoted much time to analyzing research reports for their impact on change in specifications." "Furthermore," he said, "there was broad industrial experience with the true requirements and basic understanding of what a material was expected to do in service." He continued by saying, on the other hand, if better weapons and equipment are to be devised, the metallurgists must become interested, interpret, and apply the results of this *new* research. He indicated that the traditional methods and organizations which have been responsible for publication and some analysis or interpretation of this type of work are scarcely able to kindle the desired interest because of their inability "to cope with the flood of reports and data." He warned that those who are responsible for feeding published information into specifications and methods have the greater problem of providing new data in their standards. He said: "*Standards are not dead, but rather, living, growing concepts. They feed on new data and any failure of the system which provides the data is reflected in a stunted or inadequately nourished standard.*" In failing to use the new government knowledge these groups will be "silent parties to its dissipation and loss."

He mentioned another point to the effect that government civilian agencies as well as the Department of Defense sometimes have to deviate from established governmental specifications policy which decrees they must use existing standards whenever their is no interference with national defense. Some of the equipment they are developing is not covered adequately by commercial standards. They are thus forced to write their specifications based on research which has not been performed by the traditional producer-consumer team.

On titanium, he said that the available analysis methods for titanium sponge are time consuming, complex, and incompletely standardized—that there were no well-established, simple procedures for determining oxygen, nitrogen, and carbon impurities in the sponge. He made a plea for new specifications complete enough to define a grade of sponge (1) suitable for future as well as present government needs and (2) producible under present technology.

The Government's interest in titanium stems from the metal's attractive strength-weight ratio in the 400–800 F range. The heat generated from air friction over the surfaces of faster-than-sound weapons has focused attention on metal properties in this range.

Dr. Harris pointed out that ". . .to arrive at useful and proper standards . . ." committees such as ASTM's B-2 on Non-Ferrous Metals and Alloys (currently studying a hardness method used as a partial test for acceptance of sponge by the Government) must have knowledge of the current research and development now under way in the production and applications of titanium.

Then, in discussing failures of welded ships owned by the Government during World War II, Dr. Harris noted that, investigation had revealed that the steel plate involved passed every standard specification test. He said that because of this, new tests and specifications are needed which will be tailored more to the specific applications of materials and which will detect significant variations under the special operating conditions imposed by the applications.

In having greater participation by government research people in the "general interest" groups of the standards societies' technical committees, Dr. Harris concluded that these societies would have" . . . access to the latest findings of science. . ." and that the societies' ". . .standards and specifications can reflect—not the dead past, but the living present."

NOTE.—Mr. Harris has posed what he believes to be an important question concerning the direction that standardization societies should be following. Perhaps our readers may have some ideas regarding our present policies in organizing technical committees and would like to send them to the Editor for presentation in a future issue.

Research

Aims and Purposes of ASTM Administrative Committee on Research

"THE promotion of knowledge of the materials of engineering," the foundation upon which the ASTM is built, would be a slow process without research.

Just 30 years ago, the Society realized the importance of encouraging and guiding the various aspects of research undertaken by the technical committees and accordingly established (1924) the Administrative Committee on Research (originally Committee E-9 on Correlation of Research). The six members (in addition to the committee secretary from the Headquarters Staff) of the committee are men of broad experience and background and are appointed by the Board of Directors of the Society for three-year terms. The scope of this committee reads as follows:

"This committee has for its functions broadly (*1*) to consider means by which the work of the Society in promoting knowledge of engineering materials may best be advanced; (*2*) to encourage and stimulate investigations for this purpose under the auspices of the Society; (*3*) to seek to bring about studies of those materials concerning which information is needed; and (*4*) to review annually the progress of the Society's research activities."

The some $60,000 in the ASTM Research Fund is of course insufficient to subsidize any large or extended research program, yet the Administrative Committee has done much to carry out its responsibilities as outlined in its scope. The following will indicate the many fields of research which were aided by the financial support of the committee.

1929, 1931, 1932 — Effect of aging on structural steel and its yield properties—Research Committee on Yield Point of Structural Steel

1931 — Effect of phosphorus and sulfur in steel

1931 — Study of mineral aggregates by Highway Research Board of National Research Council—Committees C-9 and D-4

1934 — Removal and transportation of atmospheric test specimens—Committee B-6

1936 — Speed of testing effect on masonry materials at University of Illinois—Committee E-1

1936 — Joint Research Committee on Boiler Feed Water Studies

1937, 1938 — Capping tests of hollow clay tile—Committee C-10 (merged in 1937 with Committee C-15)

1937 — Fatigue tests of cast iron, Committee A-3

1937 — Composition and drafting work in revising ASTM temperature charts, Committee D-2

1938 — Installation of specimens for cooperative corrosion test in cooperation with British Iron and Steel Inst., Committee A-5

1938 — Power factor test cell, Committee D-9

1938 — Soil tests, Committee D-18

1938, 1939 — Speed of testing effect on metals at University of Illinois, Committee E-1

1938 — Fiberboard investigations, Committee D-6

1939 — Painting of structural iron and steel, Committee D-1

1939 to 1943 — Fatigue of metals

1940 — Experiments on the determination of water vapor in gaseous fuels, Committee D-3

1940, 1942, 1945 — Effect of carbon and manganese on weldability of low carbon steels; work done by Engineering Foundation

1941 — Empirical flow tests, Committee E-1

1941 — Soil tests (soil mechanics nomenclature), Committee D-18

1942 — Durability of concrete; Highway Research Board of National Research Council

1944 — Racks, etc., for exposure of lead coatings, Committee B-8

1946 to 1952 — Welding Research Council (Engineering Foundation)

1946 — Photograph of mica specimens, Committee D-9

1946, 1947 — Testing of Cast Iron, Committee A-3

1947 — Development of specifications for consumer goods—Administrative Committee on Ultimate Consumer Goods

1947, 1949 — Corrosion work—Committee B-8

1951 — Fire tests, Committee E-5

This list does not include the many requests that were approved and for which funds were earmarked but never used.

To help technical committees, Society members, and potential members to be cognizant of ASTM interest in research, the Committee has published periodically in the ASTM BULLETIN, and subsequently as reprints, "Review of ASTM Research." These articles, prepared by the committee and checked by the technical committees, appeared in 1925, 1930, 1936, 1940, 1943, 1947, and 1953. Separate reprints of the 1953 article (also some of the earlier ones) may be obtained from ASTM Headquarters.

One of the current activities is the distribution of a list of unsolved research problems faced by the technical committees of the Society. This pamphlet, "Some Unsolved Problems," was prepared in April, 1952, and distributed to the officers of the technical committees and a selected number of colleges and universities. This trial distribution proved of such interest that "Some Unsolved Problems" is being revised and copies will be distributed to some 1100 accredited colleges and universities in this country and Canada. Copies of "Some Unsolved Problems" may be obtained from ASTM Headquarters.

Much more could be said about the activities of the ASTM Administrative Committee on Research but suffice it to say that the committee, under the guidance of W. C. Voss of MIT and assisted by R. C. Alden, T. A. Boyd, P. D. Brossman, O. W. Ellis, and B. W. Gonser, is anxious to be of service in connection with the research activities of all committees by (*a*) lending or giving incidental financial support to research projects, (*b*) review of research programs, (*c*) circulation of unsolved research problems, and (*d*) discussion with committee officers of other possible means of assistance.

IEC Jubilee in 1954

PRELIMINARY plans for the 1954 Fiftieth Anniversary Jubilee Meeting of the International Electrotechnical Commission in the U.S.A. were drawn up by a special committee meeting at the University of Pennsylvania in Philadelphia, last December. The IEC was organized at a meeting held in this country during the World's Fair in St. Louis in 1904.

Tentative dates for the meeting which will be held at the University of Pennsylvania are September 6–18 or August 30 to September 11, 1954.

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NINETEEN-SIXTEEN
RACE STREET
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An Essay on Annual Meetings

WHEN the end of June arrives, most any year, a number of curious bipeds wi" congregate usually on an island in the Atlantic Ocean just off the southeastern New Jersey shore. The adjective *curious* describes these bipeds because each of them is characterized by a rectangular appendage of brown or black skin—a brief case. "Curious" also partly describes the motivation for this singular migration occurring each year.

The biped is called a technical man—of the ASTM species. The yearly congregation is known as the Annual Meeting. To the other less-rare fauna of his native habitat he is known as "that scientific man down the street with the distinguished look." They see him disappear in the early Summer each year generally in the direction of the island[1] with a tremendous flapping of the brief case. Sometimes he is accompanied by his mate and offspring.

Long study of his migratory instinct reveals some interesting facts. It has been found that in general there are actually not one but at least six distinct driving forces contributing in varying degree to his irresistible urge.

First, the ASTM'er wants to learn. (He is "curious" indeed!) At home he helps his community's way of life through the use of his specialized knowledge of the forces of nature and how to control these forces. Each year he brings back from his migration additional information which only he and his company can convert into a useful part of living.

Second, this technical man wants to share and teach. He has uncovered new knowledge during the year which can be put to powerful use if he can multiply its users. The Annual Meeting affords this opportunity to expand his usefulness through presentation of a paper, participation in technical discussion periods, or helping to solve a committee problem.

Third, the ASTM'er wants to belong—to be associated with something *big*. In going to the island he is part of a conclave of other minds who have this higher goal—to seek out and grasp always, some little piece of that which is truth.

Fourth, our member is a social creature. He enjoys the unexpected, chance meetings that often occur in the lobbies, the corridors, and the session rooms at the Annual Meeting. An old schoolmate or revered professor, a close business associate from former years—he may run into any of these. From the resulting exchange of conversation and ideas taking place in these casual little meetings, he usually comes away with a sharper approach to some materials problem—this is strictly ASTM—or he may come away with a warmer understanding of his fellow-creature—this is because there has been simply a meeting with people involved.

Fifth, our man likes the change in scene and pace which is the Annual Meeting. Between sessions there are the searches on the boardwalk for a succulently cooked fresh sea bass or cherrystone clams on the half-shell. There are little journeys into the bright warm sun, the fresh salt breeze, or the green cool ocean. There are sounds of the sea smashing on sun-bleached pilings and screams of the soaring gulls.

How different are these from the ordinary back-home sounds of taxi horns, testing machines, and lawn mowers. And how different are the odors from those of back-home fumes of the city, from the laboratory, and from the basement oil burner.

Sixth, our ASTM'er, like any other technical man, likes to be rewarded. The praise from his associates for well-run test programs or ". . . authoritative, well-presented . . ." papers is a justifiable sap to his pride.

These, then, are the major urges behind the annual migration of the technical man (ASTM species) to his rendezvous—the Annual Meeting.

[1] Actually, our Annual Meeting has been held in Atlantic City 35 years out of 50.

Committee Week Dates Changed

THE date of the Society's 1954 Committee Week meetings at the Shoreham Hotel in Washington has been moved up from the first week in March to February 1 to 5.

This change was made as a result of an indicated preference of the members for an earlier date.

Schedule of ASTM Meetings

This gives the latest information available at ASTM Headquarters. Direct mail notices of all district and committee meetings customarily distributed by the officers of the respective groups should be the final source of information on dates and locations of meetings. This schedule does not attempt to list all meetings of smaller sections and subgroups.

DATE	GROUP	PLACE
May 20–21	Committee D-21 on Wax Polishes and Related Material	Chicago, Ill.
May 25–26	Committee E-11 on Quality Control of Materials	ASTM Headquarters, Philadelphia, Pa.
June 25	Joint Committee Meeting on Chemical Analysis by Powder Diffraction Methods (ASTM, American Crystallographic Association, British Institute of Physics)	Ann Arbor, Mich.
June 25–26	B-4 on Electrical Heating Resistance, and Related Alloys	Atlantic City, N. J.
June 28–July 3	**ASTM Annual Meeting**	**Atlantic City, N. J.**

Election of District Councilors Under Way

In May of each year ASTM members in the various Districts of the Society receive ballots from Headquarters for the election of District officers or councilors, or both.

The offices of chairman, vice-chairman, and secretary are filled by election in the even number years for terms of two years. The two-year terms of councilors are staggered so that about half expire every year. This means that in 1953 only elections for those councilors whose terms are ending will be held.

Under the Charter for Districts, provision is made for a nominating committee of five members appointed by the District chairman with approval of the council. This committee is usually composed of one councilor, three noncouncilors from the District, and the immediate past-chairman who heads the committee. These committes have recently been holding their meetings to prepare the recommendations which appear on the letter ballot. Provision is made on the ballot for the writing in of additional names for council membership.

William F. Black, Jr. Rejoins Staff

It is with considerable pleasure that we announce the return to the Staff of William F. Black, Jr. as Technical Editor. He had earlier been a member of the Editorial Staff but left two years ago to take a position in industry.

A native of Philadelphia, Mr. Black graduated from Drexel Institute of Technology in 1949 with a chemical engineering degree. He has had five years' industrial experience, most recently with Sharp and Dohme, Inc. as design engineer in the field of chemical plant design.

During World War II he served five years in the Army Medical Services Corps holding the rank of captain when he was discharged.

In his new Staff position Mr. Black will assist in editorial work largely in connection with publication of technical papers.

Next Issue—

The July issue of the ASTM Bulletin will carry a complete résumé of the activities and events of the 56th Annual Meeting of the Society.

Viscosity Standardization Change Effective July 1953

The National Bureau of Standards will adopt a new value for the viscosity of water on July 1, 1953. As a result of the research conducted by J. F. Swindells, J. R. Coe, Jr., and T. B. Godfrey,[1] a new value of 1.0038 centistokes at 68 F has been established in place of 1.0070 centistokes at 68 F, the value currently in use.

Accordingly, extensive revisions to Viscosity Methods and tables will be required. The ASTM Committee D-2 on Petroleum Products and Lubricants is currently preparing the necessary revisions to the viscosity standards and tentatives affected (D 445,[2] D 466,[3] D 666,[4] and D 567).[5]

The National Bureau of Standards initially proposed to adopt this new kinematic viscosity value on July 1, 1952, but, at the request of Committee D-2, granted a full year's delay in order to give proper publicity to the project and to give those concerned on opportunity to study the subject. Method D 455 – 52 T will be revised to cover the new adopted value on July 1, 1953.

Changes in viscosity measurements will be affected and changes in standards will be necessary. All kinematic viscosity measurements, for example, will be reduced by 0.318 per cent. Saybolt Universal and Furol Viscosities, however, will not be affected. This means that viscosity conversion tables ASTM D 446 and ASTM D 666 will require revision. The new tables will be available from ASTM headquarters after June 1, 1953.

The table of basic kinematic viscosity values for computing Viscosity Index will also require changes. This table, found in ASTM Method D 567, will be revised so that the Viscosity Index of a given oil will not change because of the adoption of the new standard value for water. Revised copies will be available after June 1, 1953. The table of basic Saybolt viscosity values for computing Viscosity Index will remain as at present.

Prepared booklets showing calculated Viscosity Indices for basic kinematic viscosity values similar to those issued by the Standard Oil Development Co., will also be revised to provide for the new values and will be available at ASTM headquarters later this year.

All kinematic viscometers in use will require restandardization or recalibration. Kinematic viscometers which have C-constants that are not simple numbers (that is 0.1, 0.3, 0.5, etc.) may be restandardized or recalibrated merely by multiplying their present factors by 0.99682 (or 1.0038/1.0070). However, a more complicated procedure will be required where the C-constants are simple numbers, since the physical dimensions control the value of C and any one or all of the dimensions may have to be adjusted, if it is desired to retain the simple number C-constant.

The value of secondary standard oils in use by laboratories will also have to be reduced by 0.318 per cent. The National Bureau of Standards will revise the values of the viscosity standard oils they distribute as of July 1, 1953. In addition, the American Petroleum Institute viscosity standard oils Alpha, Beta, and Gamma will have their viscosity values revised as of the same date. Any standards on hand received prior to July 1, 1953, should have the values on the labels reduced by 0.318 per cent to conform to the adopted value.

In summary, then, the following will be established as of July 1, 1953:

1. The kinematic viscosity of water at 68 F will be 1.0038 centistokes.
2. All kinematic viscosities will be reduced by 0.318 per cent.
3. All kinematic viscometers will require restandardization or recalibration.
4. No changes will be required in Saybolt viscosities or viscometers.
5. Present conversion showing kinematic viscosity to Saybolt Universal and Furol Viscosities will be invalidated. Corrected tables will be available at ASTM headquarters after June 1, 1953.
6. Present basic kinematic viscosity values for computing Viscosity Indices will be invalidated. Corrected tables may be obtained from ASTM headquarters after June 1, 1953.
7. All Secondary Standard Viscosity oils will require restandardization.

For further information, contact ASTM headquarters.

[1] J. F. Swindells, J. R. Coe, Jr., and T. B. Godfrey, "Absolute Viscosity of Water at 20°C." Journal of Research Nat. Bur. Standards, Vol. 48, No. 1, January, 1952. Research Paper 2279.

[2] Tentative Method of Test for Kinematic Viscosity, 1952 Book of ASTM Standards, Part 6, p. 187.

[3] Methods of Testing Films Deposited from Bituminous Emulsions, 1952 Book of ASTM Standards, Part 3, p. 1318.

[4] Method for Conversion of Kinematic Viscosity to Saybolt Furol Viscosity, 1952 Book of ASTM Standards, Part 3, p. 1378; Part 5, p. 268.

[5] Method for Calculating Viscosity Index, 1952 Book of ASTM Standards, Part 5, p. 237.

Southwest District Being Organized; Maxwell Speaks in Houston

ASTM President Meets Engineering Students at City's Universities

DURING the visit of President and Mrs. Maxwell and Executive Secretary Painter to Houston, Tex., March 24–27, one of the principal activities was in connection with the pending organization of the new ASTM Southwest District. The program of events included a joint meeting with the South Texas Section of the American Institute of Chemical Engineers on Friday, March 27, and meetings with the faculty and students, at Rice Institute and the University of Houston. Also held during the week was a meeting of the Nominating Committee to select officers and councillors for the new district which will include the states of Texas, Louisiana, Oklahoma, and a portion of Arkansas.

The accompanying photograph shows the American Institute of Chemical Engineers officers who arranged the technical meeting, Dr. McKetta having handled preliminary details. The ASTM Executive Secretary was introduced by Dr. W. B. Franklin, and after greetings and a short talk on ASTM, Mr. Painter introduced Dr. Maxwell. The President's talk on "Chemical Development and Engineering Materials" was of particular interest to those attending the meeting. About 85 were present at this meeting which was preceded by an inspection trip to the Cook Paint and Varnish Co. In the audience were quite a number of ASTM members, some of whom had come from a considerable distance to greet the Society officers. There were a number from Dallas and perhaps the long-distance traveler was R. L. Nordmeyer, who flew in from Mission, Tex., about 350 miles away.

Maxwell Meets Rice and Houston Engineering Students

Because of his interest in engineering education and the desirability of acquainting future engineers with the work of the Society, Dr. Maxwell during his term as President, has spoken at a number of engineering schools.

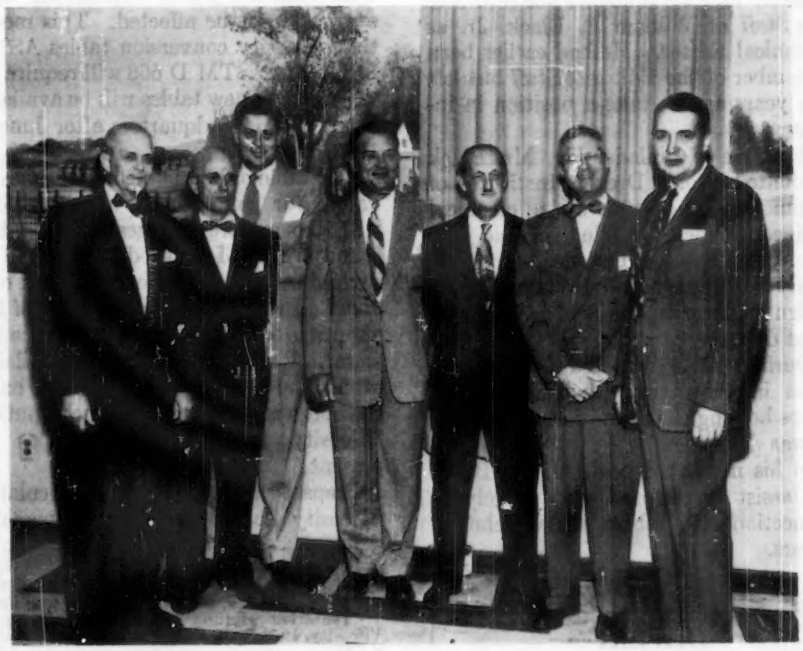
Dean M. L. Ray, of the Engineering School at the University of Houston, one of America's fastest growing schools, had arranged for Dr. Maxwell to speak to a group of engineering seniors. The President also addressed a larger group of faculty members and students at Rice Institute, one of the country's leading engineering schools. At each school the President emphasized the importance of writing and speaking well, stressing the all-important matter of brevity. In pointing out the importance of perseverance or stick-to-itiveness, he noted that "winners are made by losers who quit early," or put another way, "frequently big shots, in one sense, are little shots who kept on shooting."

An engineering editor had advised engineering students that in order to make progress they should be brief, aggressive, emphatic, positive, and be right. It was observed that such a policy might be desirable, but preferably modified as follows: be brief—politely; be aggressive—tactfully; be emphatic—pleasantly; be positive—diplomatically; be right—graciously.

Also in his talk at both the schools he referred to the emphasis which his company places on standards. There are some 16 men, mostly engineers, concerned with company-wide standards, and there is an additional group of over 20 men representing purchasing, safety, production groups, who participate in establishing necessary standards. He mentioned that in the purchase of huge quantities of materials ASTM specifications and tests play an important part. It has been amply demonstrated that the work on standards brings a very satisfactory return—as much as four to one.

Organization of Southwest District Moves Ahead

DURING earlier visits of Society officers to Houston there had been informal discussion on the organization of a district in the Southwest, and last November a group of about twenty members after reviewing the situation with the Executive Secretary recommended that a district be formally organized. With the support of this group a temporary council was appointed by action of the Board of Directors, with M. E. Holmberg as Acting



A Group at the Houston Meeting—*l. to r.*: P. L. DeVerter, Humble Oil and Refining Co.; H. D. Wilde, Humble Oil and Refining Co.; W. G. Hall, Shell Chemical Corp.; K. P. Campbell, Sheffield Steel Corp.; Harold Bone, Sheffield Steel Corp.; Executive Secretary R. J. Painter; and M. L. Holmberg, Acting Chairman, ASTM Southwest District. Mr. Holmberg has cooperated very closely in the organization of the new District, beginning with the November visit of the Executive Secretary.

At the Houston Meeting—*l. to r.*: E. E. Berkley, Anderson, Clayton and Co.; K. E. Luger, Consulting Engineer; Edwin Joyce, American Petroleum Institute; C. F. Lewis, Cook Heat Treating Co.; J. C. Earthman, Wyatt Metal and Boiler Works, and ASTM President H. L. Maxwell. As indicated, Messrs. Luger, Joyce, and Lewis served on the District Nominating Committee, the latter being chairman. Mr. Lewis was particularly cooperative in aiding the President and Executive Secretary during their Houston visit.

Chairman. The meeting of the nominating committee to select a formal council was held during the visit of the national officers, and recommendations were agreed upon. After acceptance, the names of the nominees will be referred to letter ballot of the district.

The nominating committee was headed by C. E. Lewis, Metallurgical Engineer, Cook Heat Treating Co., who has been very active in other society work in this area and who, with Mr. Holmberg, devoted considerable time to ASTM activities during the week. Associated with him representing the council, was Edwin Joyce, American Petroleum Institute, Dallas; other council members on the nominating committee included A. W. Eatman, A. B. Campbell, and K. E. Luger.

It is proposed to have on the council several vice-chairmen from various areas in the district, and the councilors will represent leading industries from industrial centers in the Southwest. Further details will appear in subsequent issues of the BULLETIN.

Joint Meeting in Atom Plant Area Hears ASTM Head

AT A Joint Meeting of the American Society for Metals and the American Institute of Chemical Engineers on March 19 in Richland, Wash. to which were invited the ASTM members in that area, ASTM President Maxwell was the guest speaker presenting the lecture that he has given at ASTM district meetings on "Chemical Developments and Engineering Materials."

This meeting was made possible through the cooperation of R. Ward, Head, Metallurgy, Applied Research Unit, Nucleonics Div., General Electric Co., which is operating the Hanford Works for the Atomic Energy Commission. The technical meeting attended by about 75, was preceded by a dinner.

Dr. Maxwell earlier had participated actively in solving some of the engineering materials problems associated with the construction and operation of Hanford Plutonium Plant.

St. Louis District Meets with Quality Control Group

THE St. Louis District members of ASTM were guests at a joint meeting sponsored by the St. Louis Section of the American Society for Quality Control on March 20, 1953. Some 60 persons were privileged to hear J. H. Toulouse, Vice-President of ASQC and Specification Engineer, Owens-Illinois Glass Co. in Toledo, Ohio. Dr. Toulouse, who discussed "Some Practice Theory and Theories in Practice," divided his subject matter in six categories to show the methods that were employed trying to develop quality control applications in an industry which hitherto had not employed such techniques.

1. Development of a quality audit system for packed ware for delivery.
2. Variation in test over an area of paperboard.
3. Semistatistical applications to measurement testing.
4. Acceptance sampling.
5. Analysis of sample size as dictated by the number of molds on the machine.
6. Field surveys of bottle use.

The second speaker of the evening was Dr. M. E. Wescott of Rutgers University who has recently returned from India, where he was a member of a teaching group of four professors sent to India by the United Nations for the holding of eight-day clinics throughout the country. Dr. Wescott talked about the customs of India and the general industrial setup there.

American Institute of Chemical Engineers Local Officers—*l. to r.*: Dr. J. J. McKetta, Gulf Publishing Co., *Chairman Elect;* Dr. W. B. Franklin, Humble Oil and Refining Co., *Chairman;* G. T. McBride, Rice Institute, *Treasurer;* D. A. Smith, Humble Oil and Refining Co., *Executive Committee.*

New England District Presents Extensive Program in Worcester

Meeting Features ASTM President, Plant Visit, and Films on Abrasives

A WELL-planned series of events including a plant visit, an address by ASTM President Maxwell, a short talk on "Application of Abrasives" by Albert L. Ball, stereoscopic slides and color pictures, combined, with good attendance, to make one of the most interesting meetings yet held under the auspices of the ASTM New England District. The meeting was in Worcester, Mass., on April 16 and was the second to be held in that city.

About 50 of those present went on the industrial trip to Plant No. 7 of the Norton Co. where they were given a complete picture of the manufacture of abrasives, cutting and polishing wheels, and many other products which come from the production lines in this almost five-acre plant. Preceding the actual trip was a brief talk by the Assistant Plant Superintendent.

A social hour preceded the dinner at the Hickory House. About 75 were present at the dinner presided over by Dr. H. H. Lester who opened the session by commenting upon the significance of ASTM work in the field of materials. He feels strongly as do many others that increasing emphasis should be placed on research to develop new and modified materials so that we can keep pace with intensified demands for new and unique properties. While he is keenly concerned with this problem from the standpoint of Army Ordnance at Watertown Arsenal, he feels that ASTM has an increasingly important role in its across-the-board concern with materials research and standardization. In introducing Executive Secretary R. J. Painter he referred to the importance of coordinating activities and work of the ASTM Staff.

Mr. Painter complimented the New England Council for its work in supporting the Society, referring particularly to the steps that are being taken to stimulate greater interest on the part of engineering school students and faculty. This work had been started by Past-President H. J. Ball and is continuing under the guidance of Prof. W. D. Clement, University of New Hampshire, both of whom were present.

A. A. Klein, Assistant Director of Research, Norton, Co., Technical Chairman of the meeting, was next introduced. Prior to his some 36 years service with the Norton Co. Mr. Klein had been with the National Bureau of Standards, associated with ASTM Past-President P. H. Bates on the constitution and hydration of portland cement.

In the opening part of the program President Maxwell gave a modified version of his talk on "Chemical Developments and Engineering Materials," stressing many of the points which must be kept in mind in the selection of materials. Two points often overlooked are maintenance costs and shutdowns. He again stressed the importance with which his company viewed standards and testified to the values of ASTM standards.

Albert L. Ball, Director of Research for the Bay State Abrasive Products Co., Westboro, Mass., who has taken a leading part in technical and research developments in the industry was next introduced by the chairman. Mr. Klein prefaced his introduction with a few notes on the history of abrasives.

The Southern California District dinner meeting in Los Angeles on the occasion of the visit of ASTM President Harold L. Maxwell and Associate Executive Secretary Raymond E. Hess. At the speaker's table, left to right: C. E. Emmons; W. M. Barr; E. O. Slater, ASTM Director; E. O. Bergman, District Chairman; H. L. Maxwell; R. E. Hess; W. C. Hanna; and C. Wakeman. Los Angeles will be the site of the Society's 1956 Pacific Area meeting for which definite planning is under way.

A special feature in the form of stereo-colored slides realistically projected the audience right into some phases of the manufacture and particularly the use of various abrasives and grinding and cutting stones. Finally, there was shown a color motion picture "The Story of Modern Abrasives." This program, a rather extensive one, was carried out on good schedule, the meeting ending about 9:45.

The program was arranged under the auspices of the New England Council, whose officers include H. H. Lester, Watertown Arsenal, *Chairman;* C. G. Lutts, Boston Naval Shipyard, *Vice-Chairman;* and R. W. Chadbourn, Boston Edison Co., *Secretary*. The program and local arrangements were carried through by Mr. Klein with the close help of R. P. Mahan, Baird Associates.

A widespread area was represented in the attendance. Several councilors and members were there from New Hampshire, Springfield, Fitchburg, Lowell, and a good number from Worcester and Boston. It was estimated that about 60 per cent of the total attendance of around 100 were visitors.

Errata in Part 1, 1952 Book of ASTM Standards

SINCE the printing and distribution of Part 1 on Ferrous Metals of the 1952 Book of ASTM Standards, several errors have been discovered. All those having copies of this book are urged to make the following corrections immediately.

Tentative Specifications for Seamless Alloy Steel Boiler, Superheater, and Heat Exchanger Tubes (A 213–52 T):

On p. 160 footnote *a* to Table I refers to grade T16. This should be changed to refer to grade T5c. The identification symbol for grade T16 was changed to T5c in 1952 but was overlooked in the footnote.

Tentative Specification for Carbon Steel Forgings for General Industrial Use (A 235–52 T):

On p. 669 the first two lines at the top of the left-hand column of type should be transposed to the top of the right-hand column of p. 668. Section 12 (*b*) will then read, "Unless otherwise specified, the axes of the specimen shall be located at any point midway between the center and the surface of solid forgings and at . . ."

Tentative Specification for Alloy Steel Blooms, Billets, and Slabs for Forgings A 274–52 T):

On p. 716 in Table I the carbon content for grade 8720 should be changed from "1.18 to 0.23" to read "0.18 to 0.23" per cent. Also in the column for molybdenum content note should be made that the word "vanadium" entered applies only to grades 6120, 6145, and 6150.

Tentative Specification for Carbon and Alloy Steel Forgings for Turbine Rotors and Shafts (A 293–52 T):

On p. 753 the present Section 11 (*b*) requires the measurement of yield strength for classes 2 to 6 at 0.01 per cent offset. This should be changed to 0.02 per cent offset and should be made applicable also to class 7. The phrase should then read "0.02 per cent offset for classes 2 to 7."

On p. 754 in footnote *a* to Table III the requirement of 0.02 per cent offset for classes 2 to 6 should be expanded to include the new class 7 added in 1952.

Attention is also called to an unfortunate typographical omission from one of the standard compounds covered by the Methods of Sample Preparation for Physical Testing of Rubber Products (D 15 – 52 T). The omission occurs in the standard formula for natural rubber compounds in Section 5 (*a*) of Method D 15. In the table in Section 5 (*a*), the numeral 1 should be inserted opposite "Benzothiazyl disulfide" in the third column under the heading "Natural Rubber, Whiting Loaded." In other words, the numeral 1 should appear in all four columns opposite the item Benzothiazyl disulfide. It is important that this accelerator of vulcanization be included in this formula as the formula as now printed in Method D15 will otherwise give trouble in curing.

This correction should be noted in Method D 15 on page 2 of the 1952 Book of Standards, Part 6, and also on page 2 of the Compilation of "ASTM Standards on Rubber Products," December, 1952.

Titanium Discussed at Joint SAE-ASTM Meeting

THE development and application of titanium was the subject of a paper presented by Dr. Howard T. Clark, Rem-Cru Titanium, Inc., at the March 31 Joint Meeting of the Pittsburgh District of ASTM and the Pittsburgh Section of the Society of Automotive Engineers. Presiding at the dinner before the technical sessions was SAE Section Chairman, K. G. Scantling, Equitable Auto Co. This dinner was held at Webster Hall and was preceded by a social hour.

At the technical meeting in the Mellon Institute auditorium just across the street ASTM District Chairman M. D. Baker presided, introducing Executive Secretary R. J. Painter and Dr. Clark. Mr. Painter noted the importance of the engineer in today's economy and especially in carrying out the important work of both SAE and ASTM. He referred to certain committee work including the activities of ASTM Committee B-2 where data are being developed on the properties of titanium and its alloys. Three specifications have been issued for iodide titanium, titanium wrought products, and ingot.

Dr. Clark outlined briefly the history of titanium noting that high purity metal was developed only as late as 1923; then ten years later the magnesium process for producing it was developed and ten years thereafter the Bureau of Mines set up a pilot plant. Dr. Clark's company procures the titanium sponge and then melts it into ingots and from these forms quite a wide variety of products most of which are going into military service.

There are several grades of titanium alloy available with tensile strengths ranging from 60,000 to over 120,000 psi. Depending upon the grade, the elongation may range from 12 to 15 to 20 per cent or so. Through various tables and charts he gave specific information on high-temperature properties, and the remarkable corrosion resistance of the material in sea water and related atmospheres.

Even though production is climbing with several thousand tons of products scheduled for the current year, it has not been possible greatly to reduce the price.

Following this talk were prepared discussions providing information on grinding and finishing of the material. Most effective grinding wheel speeds are in a quite low range. Fatigue tests at Carnegie Institute of Technology were briefly described in which a rather startling rise in temperature was noted before failure, a red heat being noted in certain cases.

Although the audience of about 150 was a mixed group including petroleum specialists as well as metallurgists from various fields, the speaker's presentation was such that all were given a clear picture of some of the production problems and especially the properties of this material.

Corrosion Committee Adds Gulf Coast and Southwest Test Sites

$100,000 Goal Reached—Extensive Corrosion Bibliography Available

Test Site Fund:

The cooperative efforts of 148 companies have resulted in the ASTM Advisory Committee on Corrosion exceeding its $100,000 goal set in 1949—this was the minimum amount estimated as being necessary to establish a limited number of test sites representative of various climates and environments. This fund is being used not only to establish sites but to service and maintain such sites and to provide the necessary pipe frames and standard specimen racks for the exposure of specimens.

It is interesting to note that the expenses of this program to date have totaled about $30,000 indicating an average expenditure of less than $8000 per year. On this basis the $103,650 received should be expected to last longer than the original ten-year period. However, many of the programs in progress anticipate a total exposure time of some 20 years and the amount in excess of $100,000 will be used for an extension of time or to provide additional facilities.

Previous contributors to this fund were included in the October, 1950, and January, February, May, and September, 1951, ASTM BULLETINS. Those who have contributed since that time are listed below:

American Cyanamid Co.
Baker Castor Oil Co.
Ball Chemical Co.
Brown Co., R. J.
Bundy Tubing Co.
Burndy Engineering Co., Inc.
Burroughs Adding Machine Co.
Canadian Pacific Railway Co.
Cities Service Co.
Columbian Carbon Co.
Continental Diamond Fibre Co.
Cook Paint and Varnish Co.
Diamond Alkali Co.
Enterprise Paint Mfg. Co.
Falk Corp.
Handy & Harman
Hanson-Van Winkle-Munning Co.
Hardesty & Hanover
Hodgman Rubber Co.
Hydro-Electric Power Commission of Ontario
Kaiser Steel Corp.
Lebanon Steel Foundry
Lilly Varnish Co.
Maas & Waldstein Co.
Naylor Pipe Co.
Niagara Mohawk Power Corp.
Norfolk & Western Railway Co.
RCA Labs., Radio Corp. of America
Southern Railway System
United Co-operatives, Inc.

New Test Sites:

As indicated in the September, 1951, BULLETIN, test sites have been set up in the Canal Zone, Kure Beach, N. C., Point Reyes, Calif., New York, N. Y., East Chicago, Ind., Columbus, Ohio, and State College, Pa. Two additional sites have recently been added.

A Gulf Coast site has been established on grounds owned by the Freeport Sulphur Co. and currently under the jurisdiction of the U. S. Corps of Engineers. This site is located in the floodgate area at the mouth of the Brazos River, Freeport, Tex., and is representative of the general conditions prevailing along the coast of the Gulf of Mexico. Thus exposure test sites representative of the three coastal areas of continental United States are now available.

In addition to the rural site at State College, Pa., a desire was expressed by the plastics and adhesive people for an exposure station in the southwestern part of the United States, typical of that hot, dry section of the country. Such a site has now been established through the courtesy of the Coronado National Forest and is located on the grounds of the Southwestern Forest and Range Experiment Station at Tucson, Ariz.

ACC Report:

The 1952 *Proceedings* contain a comprehensive report issued by the Advisory Committee on Corrosion. Appendix I of this report is a bibliography of the corrosion papers and symposiums published by the ASTM since its inception. There are several hundred listings in this bibliography which should be of interest to anyone concerned with corrosion.

Work of the committee during the past year included the preparation of a Society-wide corrosion exhibit which was on display in connection with the Fiftieth Anniversary meeting and exhibit of the Society held in New York in June of last year. This exhibit included:

Committee A-3 on Cast Iron.—A number of photographs mounted and lettered by the International Nickel Co. comprising an area of about 12 by 18 in., a diesel engine cylinder liner made of cast iron, and a section of a larger liner also cast iron.

Committee A-5 on Corrosion of Iron and Steel.—Through the cooperation of Consolidated Edison, a number of colored photographs were mounted in an attractive green and rose display board. In addition a number of colored stereoptican slides and electric viewer were made available by O. B. Ellis, Armco Steel Corp.

Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys.—Contributed four small photographic charts showing zinc weight loss at various locations, an 8 by 12-in. chart showing iron weight losses at four locations and samples of an iron panel at each location.

Committee B-4 on Electrical Heating, Resistance, and Related Alloys.—Submitted a number of specimens showing the effect of temperature on furnace elements, life tests of various strip materials, and examples of green rot.

Committee B-6 on Die-Cast Metals and Alloys.—Loaned 134 8 by 10 in. black and white photographs showing the effects of 10 and 15-yr exposure of aluminum, zinc, and magnesium specimens exposed at five outdoor and four indoor sites.

Committee B-7 on Light Metals and Alloys, Cast and Wrought.—Submitted three specimens of magnesium alloys exposed six months at State College, Pa.

Committee B-8 on Electrodeposited Metallic Coatings.—Prepared an attractive display showing the effects of atmospheric exposure on copper-nickel-chromium plating on steel and lead plating on steel at four locations.

Committee D-1 on Paint, Varnish, Lacquer, and Related Products.—Supplied six photographs of the metal panels which had been exposed for 41 months. These panels showed the effect of dirt retention and corrosivity as related to 1 and 2 coated application of 3 formulas.

The display centered about a 4-ft map of the United States showing the various ASTM test site locations.

The committee will in the future publish more frequent reports than has been the case in the past—perhaps annually if progress warrants such publication.

A 1953 report is planned which will include an appendix showing views of all ASTM test sites and their general environments. The total number of ASTM test sites is now 22, located as follows:

Altoona, Pa.
Ames, Iowa
Annapolis, Md.
Brazos River, Freeport, Tex.
Bridgeport, Conn.
College Station, Tex.
Columbus, Ohio
Davis, Calif.
East Chicago, Ind.
Ithaca, N. Y.
Key West, Fla.
Kure Beach, N. C.
Lafayette, Ind.
Manhattan, Kans.
Miraflores, C. Z.
New York, N. Y. (Bell Tel. Labs., Inc.)
New York, N. Y. (Port of N. Y. Authority)
Pittsburgh, Pa.
Point Reyes, Calif.
Santa Cruz, Calif.
State College, Pa.
Tucson, Ariz.

Use of Facilities:

Increasing use is being made of the new test site facilities. Committee B-7 on Light Metals and Alloys has exposed more than 1500 (at each site) aluminum and magnesium specimens in the form of sheet, plate, and tension specimens at New York, Kure Beach, and State College. Further plans call for the exposure of a like number of specimens at Point Reyes, Calif., and Freeport, Tex.

The American Welding Society has received permission to expose specimens at New York, Kure Beach, Columbus, Point Reyes, East Chicago, and Freeport. It is expected that these specimens will be on exposure within the next few months.

The Steel Founders Society has requested permission to expose a number of cast steel specimens at the East Chicago location and this request recently has been approved by letter ballot of the Advisory Committee on Corrosion.

Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys, Subcommittee VII on Weather, has initiated tests to determine the relative corrosivity of the various sites. Calibration specimens of zinc and iron have been exposed at New York, Kure Beach, and Point Reyes and additional exposures are contemplated for some of the other locations.

Subcommittee VIII on Galvanic and Electrolytic Corrosion—Part 1 (consisting of disk-type couples) of a three-part galvanic couple program of magnesium specimens is one-third complete, the first of three groups of specimens having been removed last year. Part 2 consisted of wire wound bolt-type couples, duplicate specimens of which were exposed for three consecutive 4-month periods as well as a total exposure time of 12 months. This part of the program was completed last winter. Part 3 which consists of plate-type couples is still in the planning stage.

Committee B-6 on Die-Cast Metals and Alloys, Subcommittee V on Exposure and Corrosion Tests, is planning to expose specimens of material left over from the original B-6 program and which have been kept in storage until the present time. These exposures will be made at New York, Kure Beach, and Columbus.

Additional Contributions:

In view of the progress already made by the Advisory Committee on Corrosion and the use to which these sites are being put, some additional companies may now feel ready to make a contribution to the ASTM test site fund. Additional contributions will be appreciated and may be drawn to the order of ASTM Test Site Fund and sent to the Executive Secretary, ASTM, 1916 Race Street, Philadelphia 3, Pa.

NBS Study of Gas Viscosities

To provide data needed for the design of gas turbines and jet engines, the National Bureau of Standards is conducting a broad program of research on the viscosity of gases at elevated temperatures and pressures. Under the sponsorship of the National Advisory Committee for Aeronautics, hydrocarbon mixtures and combustion products composed of various proportions of nitrogen, carbon dioxide, argon, oxygen, carbon monoxide, and water vapor are being studied. In the course of this work, a unique type of flowmeter has been developed which accurately controls and measures the flow of very small volumes of gas, such as those required in a small capillary tube viscosimeter. As a result of this development, it has been possible to obtain data hitherto unavailable on the viscosity of pure gases and their mixtures.

At present, available data on the viscosity of gases are very meager, particularly at temperatures above 1000 F. To meet this need, the National Bureau of Standards has undertaken to determine the viscosity of pure gases and gas mixtures at pressures from 5 to 10,000 psi and over the temperature range from 60 to 2500 F.

New Acoustical Standard from ASA

A new American Standard of interest to ASTM members has been prepared by the American Standards Assn., Sectional Committee Z24—Acoustics, Vibration, and Mechanical Shock, sponsored by the Acoustical Society of America. The specifications cover Octave-Band Filter Set for the Analysis of Noise and Other Sounds (Z24 – 10).

The standard provides for an octave-band filter set limited to the requirements for analyzing, as a function of frequency, an electrical signal obtained from an electroacoustic-transducer-amplifier combination driven by a noise or other sound. It is intended to assure that the analysis of a noise with such a set will be consistent within known tolerances.

Copies of this American Standard can be obtained from American Standards Assn., 70 E. 45th St., New York 17, N. Y. for 50 cents.

Electroplaters' Annual Convention

The 40th Annual Convention of the American Electroplaters' Society will be held June 15 to 18 at the Benjamin Franklin Hotel in Philadelphia, Pa. The Philadelphia branch has prepared a technical and social program that promises to set the standard of excellence for Electroplaters' Conventions of the future.

The technical sessions will cover a wide variety of subjects, highlighted by a symposium on chromium plating. Papers carefully selected to cover all phases of plating include cost estimating, the control and effect of cyanide decomposition, recent developments in the plating field, test procedures, etc. A special round-table question period will be conducted on the evening of June 16. All speakers will be present but it is anticipated that the major portion of the discussion will be from the floor.

Correction

On page 23 of the April issue of the Bulletin, a new Tentative Method for Determination of Cross-Sectional Area of Stranded Conductors was erroneously designated as B 265. The correct designation of the Method is B 263

TECHNICAL COMMITTEE NOTES

Evaluation Standards Development Keynotes C-19 Meeting

CONTINUING activity and attention to the establishment of needed standards to evaluate structural sandwich constructions, as well as the constituent parts thereof, was the keynote of reports at the Spring Meeting of Committee C-19 on Structural Sandwich Construction. The Chance Vought Aircraft Division of United Aircraft Corp. was host to the committee on April 9 and 10 at the Dallas, Tex., plant. The cordial reception at the Chance Vought Plant was made even more enjoyable by a conducted tour.

Subcommittee I on Mechanical Properties of Basic Materials continued discussions of test methods to determine properties of core materials. Included were test methods for compression, delamination of honeycomb cores, shear, heat distortion, and thickness. The subcommittee recommended that the existing tentative test methods for determining core density and core water absorption be adopted as standard, following letter ballot to the entire committee.

Subcommittee II on Mechanical Properties of Basic Sandwich Construction convened to discuss test methods to determine peel strength, compressive properties, tensile strength, shear properties, and flexural properties of complete structural sandwich constructions. It was also recommended that the present tentative test method for determining shear properties be adopted as standard, subject to letter ballot of the entire committee.

Subcommittee III on Permanence, Durability and Simulated Service continued discussions of possible exposure of test specimens at sites sponsored by the Advisory Committee on Corrosion. The possibility of including some test cubicle for certain sandwich constructions was mentioned. A test method for determining fatigue properties of cores and sandwich constructions is being considered.

Subcommittee IV on Nomenclature and Definitions resumed discussions of possible definitions or nomenclature for different types of core materials. The subcommittee recommended the present Tentative Definitions of Terms Relating to Structural Sandwich Construction be adopted as standard, following letter ballot to the entire committee.

A dinner meeting was held at the Adolphus Hotel. Two papers were presented which proved to be most interesting, particularly as evidenced by the discussion following each paper. The first paper was "A Miniature Creep Tester for Lap Shear Aluminum Specimens Bonded with Honeycomb Sandwish Adhesives" by Dr. Steven Yurenk of Douglas Aircraft. The second paper was "Performance of a Sandwich Proof Tester" by Dr. W. S. Ericksen of the U. S. Forest Products Laboratory.

The Fall Meeting of the committee is scheduled for October 7 and 8 in Baltimore, Md., or Philadelphia, Pa.

Progress Marks Electrical Committee's Spring Meeting

COMMITTEE D-9 on Electrical Insulating Materials held a well-attended and very productive meeting at Pocono Manor, Pa., on March 25–27. There were meetings of 14 subcommittees and sections in addition to the Main and Advisory Committee meetings. The Subcommittee on Liquid Insulation was especially active.

One of the highlights of the meeting was a Discussion on Measurement of Dielectric Constant and Dissipation Factor held on Thursday evening,

Members of Committee C-19 Photographed at Their April Meeting. Front row, left to right: C. Campbell, Chance Vought; H. Epstein, Chance Vought; T. Martin, WADC-WPAFB; W. Ericksen, Forest Products Laboratory; L. Smith, Convair; R. Carl, Bureau of Aeronautics; J. Case, Plaskon Division—L.O.F.; M. Rudick, Chance Vought; D. Reid, Chance Vought.
Back row, left to right: S. Yurenka, Douglas; H. Kleindienst, Chance Vought; R. Johnston, Piasecki Helicopter; B. Forcht, Chance Vought; L. Bowles, Jr., General Electric; J. Gibbud, Owens-Corning Fiberglas; D. Hall, Glenn L. Martin Co.; G. Bentinck, Chance Vought; D. Tooley, Convair; T. Pajak, Consultant; W. Smith, Convair; W. Emerson, Goodyear Aircraft; E. Hartman, Alcoa; W. Bailey, Convair; E. Kuenzi, Forest Products Laboratory; W. Kennedy, Dow Chemical; I. Wolock, National Bureau of Standards.

March 26. The program consisted of the following:

R. F. Field (now retired from the General Radio Co.) described the status of the revision of ASTM Methods D 150 for Power Factor and Dielectric Constant, with particular emphasis on some of the problems of greatest current interest.

A. H. Scott (National Bureau of Standards) discussed two-terminal and three-terminal measurements; when each type of measurement is preferred and why.

I. G. Easton (General Radio Co.) commented briefly on some considerations regarding guard circuits.

H. T. Wilhelm (Bell Telephone Labs.) presented a very interesting description of the mutual inductively coupled ratio arm bridge.

E. H. Povey (Doble Engineering Co.) described some aspects of bridge circuits which are partially balanced and partially direct-reading on deflecting meters.

Subcommittee Progress

The *Subcommittee on Insulating Varnishes* and its various sections have been especially active. New tests are being developed for the following types of insulating varnishes: oxidizing, heat reactive, laminating, and silicon. In the case of the silicon varnishes, round-robin tests are under way on dielectric strength, draining, and time of drying.

Progress was reported on new specifications for high-temperature tubing. The impact test Method D 256 is being revised in cooperation with Committee D-20. Revisions are contemplated in the Methods of Test for Power Factor and Dielectric Constant Parallel with Laminations of Laminated Sheet and Plate Insulating Materials (D 669), Specifications for Nonrigid Vinyl Chloride Plastics (D 744), and Method of Test for Heat Distortion Temperature of Plastics (D 648).

The many projects under study by *Subcommittee IV on Liquid Insulation* required meetings extending over two days. Final action was taken regarding a footnote to be added to the General Methods of Testing Electrical Insulating Oils (D 117) regarding the interfacial tension test. Submitted for D-9 letter ballot were additional statements on significance of test and definitions applying to Askarels to be included in Methods D 901. A new test for corrosive sulfur was completed and submitted for publication as tentative. The Tentative Methods of Test for Sludge Formation in Mineral Transformer Oil (D 670) now contains two procedures, a Method A: Sludge Accumulation Test, and a Method B: High-Pressure Oxidation Test. Consideration is being given to separating these two test procedures. At this meeting, the committee received reports of round-robin tests on neutralization number, steam emulsion, dielectric strength, and sludge testing. Subcommittee IV is planning to sponsor another Symposium on Insulating Oils in September 1954, in connection with a meeting of the International Electrotechnical Commission to be held in Philadelphia at that time.

The Subcommittee on Insulating Papers has been especially active. Action was taken to revise the Tentative Methods of Sampling and Testing Untreated Paper Used for Electrical Insulation (D 202) to include four additional statements regarding significance and also a new test method for bursting strength over 200 psi. The Section on Chemical Tests is developing methods for determining chlorides (less than 50 ppm), acidity or alkalinity by potentiometric end point, and pH of unbuffered, neutral papers. A new test for dielectric strength of insulating papers has been prepared. Study is being made of a test for uniformity of absorption of laminating papers of the type covered by Specifications D 1080. The Section on Mechanical Properties has in preparation a test method for stretch of creped insulating papers. The Section on Specifications has revised the Tentative Specifications for Absorbent Laminating Paper for Electrical Insulation (D 1080) and has completed new Tentative Specifications for Insulating Paper of the Interlayer Type. Work is being undertaken on the preparation of specifications for capacitor tissues. This subcommittee is proceeding with a study of an accelerated life test for capacitor tissues.

Subcommittee XII on Electrical Test received for ballot a comprehensive revision of the Tentative Methods of Test for Power Factor and Dielectric Constant of Electrical Insulating Materials (D 150). New Tentative Methods of Test for Dissipation Factor and Dielectric Constant of Aviation Fuels was also received for letter ballot vote. This method is intended for testing aviation gasolines and jet fuels at frequencies from 25 cycles per sec to 1 megacycle per sec and at temperatures from −65 F to +130 F. The dielectric constant of aviation fuels is particularly significant in the proper functioning of capacitance-type fuel-quantity indicating gages for aircraft. The gage usually is calibrated for a specific type of fuel. A suitable calibration is most readily achieved by using a test air capacitor of value equal to the calculated value of the capacitance of the sensing capacitor used in the fuel system when filled with fuel. In order to establish a suitable calibration, the dielectric constant of the fuel must be known. Also, the accuracy of fuel-quantity measuring system is a function of dielectric constant uniformity of a given fuel. Aviation fuels normally have low dissipation factors, and a test specimen exhibiting an abnormally high dissipation factor would be suspected of being contaminated.

Technical Papers Highlight Plastics Committee Meeting; Intense Activity Reported

THE Spring meeting of Committee D-20 on Plastics held at Pocono Manor, Pa., on March 23–25 was featured by a Papers Session with the following three technical papers presented:

"Increasing the Efficiency and Economy of Experimentation," by E. Harrington, Monsanto Chemical Co.

"Evaluation of the Boor-OQMG Snag Tester," by J. J. Lamb, C. Brown, L. Boor, and F. W. Reinhart, U. S. Government

"Demonstration of the 'Dozi' Impact Strength Tester," by Robert Burns, Bell Telephone Laboratories

The first paper was a continuation of the program of refresher courses in statistics applying to testing. In connection with the third paper there was an interesting demonstration of the pendulum-type impact machine which is so designed that the "toss-factor" error is reputed to be substantially eliminated.

The American Committee of the ISO TC/16 on Plastics of the International Organization for Standardization also held a meeting on March 25 and completed plans for the third meeting of the International Committee to be held in Stockholm, Sweden, from August 10 to 14. A very representative American delegation is expected to attend this next meeting. The chairmanship of the American Group for ISO TC/61, which is assisting the American Standards Association in the duties of the Secretariat, has been accepted by Robert Burns, succeeding E. B. Cooper.

New and Revised Test Methods

Committee D-20 has been especially active during the year, and at this meeting work was completed on a number of recommendations covering new and revised specifications and test methods which will be presented to the Society in June.

An important new specification covers laminated thermosetting decorative sheets. These specifications cover two grades, a standard grade and a cigarette-proof grade. These decorative sheets consist essentially of layers of fibrous

sheet materials impregnated with thermosetting condensation resins which have been consolidated under heat and pressure. The scope of applications for these materials includes the following: (1) counter and table tops for use in restaurants, cafeterias, and bars, (2) sink tops and kitchen work surfaces, (3) dinette tables, (4) baseboards, (5) wainscoting, and (6) wall paneling.

An important new proposed tentative method covers a test for shrinkage of molded and laminated thermosetting plastics at elevated temperatures. This test is not expected to predict the behavior of materials in service but rather provides a means of classifying plastics with respect to shrinkage on a relative basis. Plastics experience dimensional change at elevated temperatures at varying rates, usually quite rapidly during the early stages and more slowly at the end of long periods of exposure. Different kinds of plastics do not behave similarly. For purposes of control work, short exposure periods will usually suffice to indicate shrinkage differences among different batches of the same material. Exposure periods of greater duration will more nearly reflect real differences in shrinkage phenomena, in comparing unlike materials for suitability in particular applications. By the use of this method it is possible to measure the change in dimensions of specimens at prescribed intervals during their exposure to circulating air at an elevated temperature.

A timely revision has been completed in the Tentative Specifications for Nylon Injection Molding Compound (D 789). Requirements have been added for one additional composition suitable for molding or extrusion; also the specifications have been brought into agreement with present industrial products.

An extensive revision has been completed of the Tentative Specifications for Vinyl Chloride-Acetate Resin Plastic Sheets (D 708). These specifications will now cover rigid sheets made of vinyl chloride polymers and copolymers. They do not cover either molded rigid products other than sheets or nonrigid (elastomeric) products. The chief characteristics of vinyl chloride polymer and copolymer sheets are thermoplasticity, toughness, resistance to water and chemicals, and dimensional stability. These materials are suitable only for applications involving relatively low loads and operating temperatures not exceeding 140 F.

Work in Subcommittees

The *Strength Subcommittee* has under way a round-robin study of the tensile properties of rigid plastic sheeting which will result in a revision of Method D 882. Extensive data have been obtained in a round-robin study of the skee-ball impact test which will be analyzed statistically. Revisions are in preparation of the Tentative Methods of Test for Impact Resistance of Plastics and Electrical Insulating Materials (D 256). A test for bursting strength is under development. A round-robin program for dynamic tests is being initiated.

The new Methods of Test for Resistance to Abrasion of Plastic Materials (D 1242) was recently published in Part 6 of the 1952 Book of ASTM Standards. This method covers two procedures, one using loose abrasive, and the other a bonded abrasive on cloth or paper. This method is a companion test to the Tentative Method of Test for Resistance of Transparent Plastics to Surface Abrasion (D 1044).

The *Subcommittee on Thermal Properties* reported that studies are under way on the following: heat distortion test for thin films, brittle temperature test for films, and a flammability test.

The *Subcommittee on Optical Properties* is continuing its studies of techniques for measuring small color differences. In cooperation with the National Bureau of Standards there are in preparation permanent haze standards for the Tentative Method of Test for Haze and Luminous Transmittance of Transparent Plastics (D 1003).

Methods for outdoor weathering are under development by the *Subcommittee on Permanence Properties*. Methods for extraction of plasticizers from cellulosic plastics and tests for heat stability of plasticizers are under study. A round-robin study of a revised method for particle size determination of vinyl chloride resins is being initiated.

The *Subcommittee on Definitions and Nomenclature* has been especially active. At this meeting several new terms to be added to the Tentative Definitions of Terms Relating to Plastics (D 883) were critically reviewed. Among the new definitions on which agreement has been reached are those for Alkyd Plastics, Polyester Plastics, Halocarbon Plastics, Resin, Meta-Stable, Plasticizer, Reinforced Plastic, and Filler. Action was taken to establish a new section to review and bring up-to-date the Standard Descriptive Nomenclature of Objects made from Plastics (D 675).

Shipping Containers Committee Organizes Study of Test Methods

THE primary consideration at the Spring Meeting of Committee D-10 on Shipping Containers was the coordination of the three subcommittees concerned with methods of tests, performance standards, and correlation of test data. The main committee met on April 22 and 23 at the Conrad Hilton Hotel, Chicago, Ill., preceded by the meeting of the Advisory Subcommittee on the evening of April 21. Concluded studies by Subcommittee IV on Performance Standards and data collected by Subcommittee V on Correlation of Test Data have pointed to the need for a review of the factors affecting the results of standard test methods now being used in evaluating shipping containers. The studies to date have been confined to the drop test (D 775) and the revolving drum test (D 782). A program of work based on the three subcommittees working jointly for an indefinite period was agreed upon.

Under the combined subcommittee setup, four task groups were organized to study particular test methods. The task groups formed will cover the revolving drum test, vibration test, drop test, and stacking test. The primary purpose of the task group programs will be to study all of the factors involved in the operation of the respective test method, details of apparatus, and personnel involved, in an attempt to establish greater precision and reproducibility of results.

In addition, reports were presented from existing task groups. The development of a test method for determining the puncture resistance of multiwall paper shipping sacks was dropped until a new, more promising approach to the problem can be made. The task group organized to study statistical methods will be reorganized, and the preliminary report presented last year will be reviewed.

Subcommittee I on Definitions reviewed the replies received on the letter ballot on the acceptance of the proposed glossary of terms for interior packing. This resulted in several changes which will be proposed in the list. An additional group of definitions for inclusion in the Standard Definitions of Terms Relating to Shipping Containers (D 996) was also reviewed in terms of comments received on ballots to date.

Subcommittee VI on Interior Packing, reported that the bibliography and abstract of cushioning studies will be completed in the near future. A proposed load deflection method for determining energy absorption of cushioning materials was reviewed, and check determinations will be made between now

and the Fall Meeting. The measurement of compression set of cushioning materials was discussed, and tests will be made to develop data for a constant load method.

A memorial resolution commemorating former chairman T. A. Carlson was presented by L. J. Markwardt, chairman of a special subcommittee designated for this purpose. A special election was held to fill the vacancies of chairman (due to the death of T. A. Carlson) and secretary (due to the resignation of J. H. Toulouse). A nominating subcommittee, under the chairmanship of W. B. Lincoln, nominated Gordon E. Falkenau, du Pont de Nemours and Co., as chairman and R. F. Uncles, American Cyanamid Co., as secretary. Messrs. Falkenau and Uncles were unanimously elected.

Following the main meeting and luncheon on April 23, a trip was made to the Central Research Laboratory, Association of American Railroads, to witness a demonstration of the railroad test track. The next meeting of the committee is scheduled for October 22 and 23 at Boston, Mass.

Forest Products Research Society to Meet in Memphis

THE Forest Products Research Society will hold its 7th Annual Meeting on June 15 to 17, 1953, in Memphis, Tenn., at the Peabody Hotel.

The three-day session will include 40 papers covering such topics as: quality control, glues, containers, finishing, composition board, chemical utilization, seasoning, and wood machinery. There will be exhibits by suppliers, and plant tours to the many wood and millwork plants in the Memphis area.

Antifreeze Group Requests New Low-Temperature Thermometer Specifications

AN INTERESTING and well-attended meeting of Committee D-15 on Engine Antifreezes and its seven subcommittees was held in Washington, D. C., on April 7 and 8. These meetings were preceded by a meeting of the Advisory Committee on April 6.

Subcommittee I on Freezing Point Determination reviewed at its meeting the Tentative Method of Test for Freezing Point of Aqueous Engine Antifreeze Solutions (D 1177). Action was taken to request the ASTM Subcommittee on Thermometers, of Committee E-1, to prepare detailed specifications for a thermometer for use in this freezing point method with a temperature range of −65 F to +40 F. Due to the low temperature this thermometer will be constructed with a mercury-thallium alloy as the liquid.

Action was taken to revise the Tentative Specifications for Hydrometer-Thermometer Field Tester for Engine Antifreezes (D 1124) to make it clear that the over-all test for accuracy covered in Section 10 is intended to apply only in the case of materials for which the tester was designed. Consideration was given to the need for information on calibration of hydrometer floats and a study group on the subject was set up.

The Subcommittee on Physical Properties recommended the adoption as standard of the Tentative Methods of Test for Boiling Point of Engine Antifreezes (D 1120), and for Specific Gravity of Concentrated Engine Antifreezes by the Hydrometer (D 1122).

Action was taken to revise the Tentative Method of Test for Ash Content of Concentrated Engine Antifreezes (D 1119) to provide for the use of a muffle furnace as an alternate to the gas burner now specified. The Subcommittee on Chemical Properties also reported completion of a method of test for determination of pH of engine antifreezes. This method will be submitted to letter ballot of the main committee for publication as tentative. The problem of revising the Ash Method to include a solids determination is under consideration. In response to an indicated need for analytical methods for glycol types of engine antifreezes it was decided to appoint a small study group to undertake this project.

The Subcommittee on Effect of Antifreeze on Rubber Hose reviewed the results of the recent collaborative beaker immersion test on representative radiator hose rubber in assorted commercial antifreezes. Plans were completed for a further series of tests by six laboratories of certain variables such as the method of agitation and velocity of the coolant.

The Subcommittee on Simulated and Actual Service Testing discussed the results of a cooperative investigation by five laboratories of certain test conditions in the proposed glassware corrosion test procedure that has been under development. The experience with this method has indicated that the glassware corrosion test must be regarded as a screening tool only and that it cannot be used alone as an indication of satisfactory antifreeze corrosion inhibition. The method can be used to distinguish between satisfactory and unsatisfactory types of antifreezes. A further cooperative study will be undertaken with about 12 laboratories participating in a

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round-robin-test in which specimens of iron and aluminum will be tested in some five or six different samples of antifreezes.

Proposed specification requirements for engine antifreezes are being deferred until there are available additional test methods such as a corrosion test and a test for the effect of engine antifreeze on rubber which are now actively under development.

Committee C-18 Seeking Samples of Weathered Building Stones

In an article in the October, 1951, issue of the ASTM Bulletin Committee C-18 on Natural Building Stones solicited samples of weathered building stones to assist in the development of test procedures. There was some response to this request, but an insufficient number of samples has been received to date to provide suitable information. The committee is now reiterating its need for more samples.

Samples of building stones of every variety from older buildings and structures being repaired or torn down are desired.

An ideal specimen would be 12 by 12 by 2½ in. but any specimen is better than none. Where spalling, exfoliation, or serious disintegration of the surface of stone has taken place, a sample of scales and powder should be collected from the weathered surface, preferably during a period of dry weather.

For all samples as much of the following information as is readily obtainable should be noted:

1. Name of building or structure.
2. Location or "address."
3. Date of erection, if known; if not, approximate age.
4. Kind of stone; quarry if known.
5. What kind of stone or material lay above the spalled or weathered stone in the building or structure. If stone is discolored or stained (other than by surface dirt) conditions and materials found below and behind stone, as well as above it.
6. Type and condition of mortar beds and joints.
7. Presence or absence of concrete backing.
8. Original surface finish of stone.
9. Is stone veneer or heavier stone?
10. Name of contractor or setter.
11. Comment on local environment. Rural? Residential? Urban? Industrial? Smoky? Fill about building? Marshy? Vegetation or soil in contact?

Send samples to: F. S. Eaton, Secretary ASTM Committee C-18, 151 Court St., New Haven 10, Conn.

Adhesives Group Considers Old and New Tests

The spring meeting of Committee D-14 on Adhesives was held at the Netherlands Plaza Hotel in Cincinnati, Ohio, on April 9 and 10. The meeting dealt with the work which has been accomplished in the several subcommittees, and an attempt to appraise general interest in the test methods that have been developed by D-14. It appears that although there are only a few using some methods, these methods do fill a definite need in these cases.

New proposed methods presented to the committee for approval include: consistency of adhesives, determining storage and working life of adhesives, electrical tests of adhesives, and testing the mold contamination of adhesives. Sample requirements for flexural and tensile strength tests are under critical review, as well as those of adhesive solids determination, and salt water resistance of adhesive bonds. It was proposed that a method should be prepared involving the use of the tackmeter. A new group was appointed to take up the problem of sampling both liquid and solid adhesives, as well as sampling materials before tests and in finished assemblies.

At a meeting of the Subcommittee on Research, data on gap-filling tests, gathered at the University of Michigan, were presented. The method used is essentially the gluing together of two rectangular blocks of wood with a ring-type shim completely enclosing the bond area. The blocks are clamped with the shim and the glue is introduced under pressure to the glue line through a hole in one of the blocks.

It was decided that the next meeting be held in Wyandotte, Mich., October 14 to 16.

For further news of the ASTM Wood Committee's big **Wood Pole Research Program**, please turn to page 63.

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Rubber Strip Adhesion Tester*

By S. A. Eller[1]

NOTE.—The opinions or assertions contained herein are the private ones of the author and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.

THE adhesive strength of bond of rubber materials to metal is a significant property in determining the suitability of Naval elastomer materials, such as protective coatings, rubber-to-metal cements, rubber bearings, etc. To evaluate this property, the rubber strip adhesion tester described below was designed. This apparatus is used in measuring the force required to separate a rubber strip from a metal base at a definite jaw separation speed and with the separating force applied at right angles to the base, thereby providing reproducible test conditions.

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* Presented at a meeting of Subcommittee XX on Adhesion Tests of Committee D-11 on Rubber and Rubber-Like Materials held during the Fifty-fifth Annual Meeting of the Society, New York, N. Y., June 25, 1952.

[1] Material Laboratory, New York Naval Shipyard, Brooklyn, N. Y.

APPARATUS

The rubber strip adhesion tester shown in Figs. 1 and 2 is primarily an attachment to be used with a standard Scott tension machine. The tester consists of a base, *1*, bolted to the traveling jaw, *2*, of the tension machine. The uprights, *3*, of the base are drilled to form bearings for the shaft, *4*. The shaft threads into a rider, *5*, is keyed to two collars, *6*, and is turned by the handle, *7*. The rider slides on two guide rods, *8*, (only one of which is visible on the photograph). The arrangement is such that rotation of the handle imparts horizontal motion only to the rider. Bolted to the rider is an adapter plate, *9*, which has two clamps, *10*, (only one of which is shown) secured to 4 studs on the plate. The clamps form a T-slot into which the metal plate, *11*, with the rubber strip, *12*, adhered thereto is placed. About 2 in. of the strip sample are separated from one end of the plate and gripped by the friction clamp, *13*, which is suspended from the load measuring head of the tension machine by the steel chain, *14*. The brace, *15*, was removed from its usual position on the uprights to show more clearly the construction of the apparatus.

PROCEDURE

The adhesion tester is bolted to the traveling jaw of the tension machine and a test specimen, which consists of a

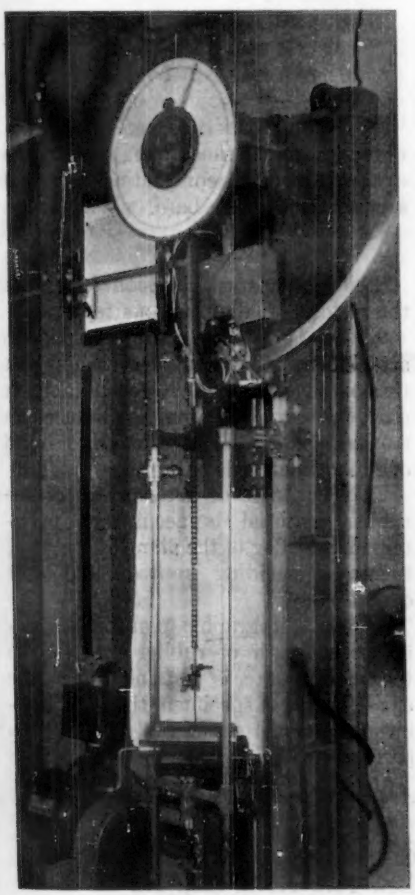

Fig. 1.—Over-all View of Strip Adhesion Tester on Scott Tension Machine.

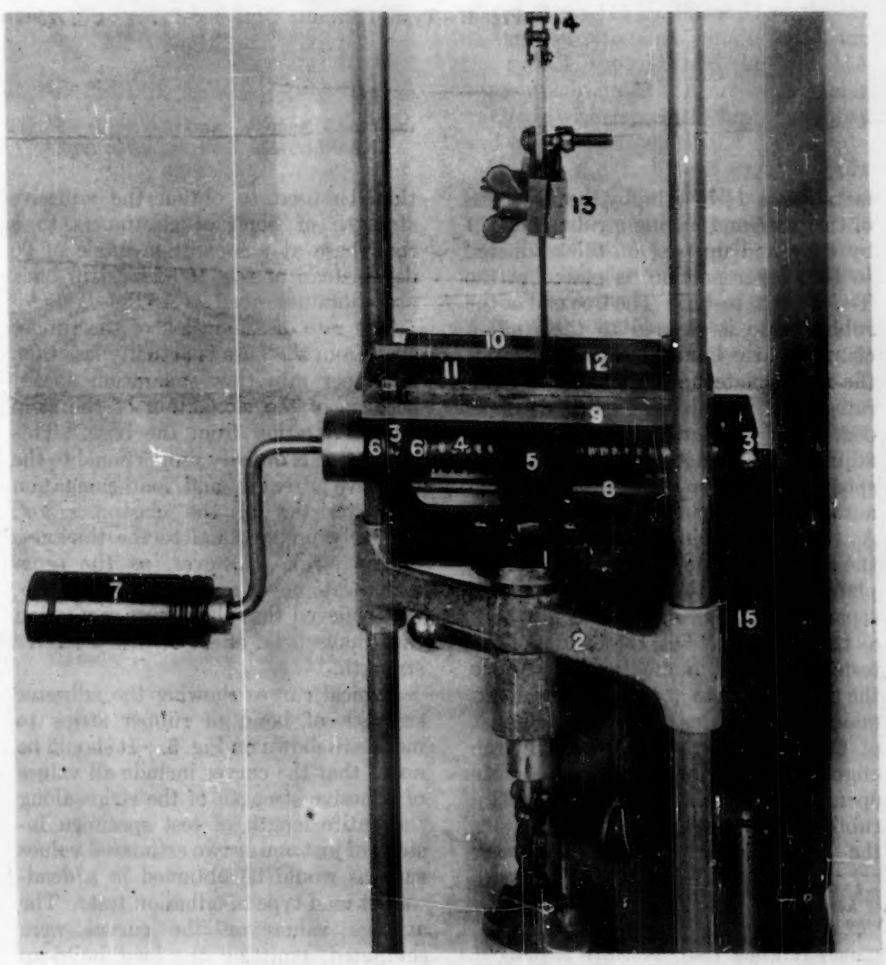

Fig. 2.—Close-up of Strip Adhesion Tester.

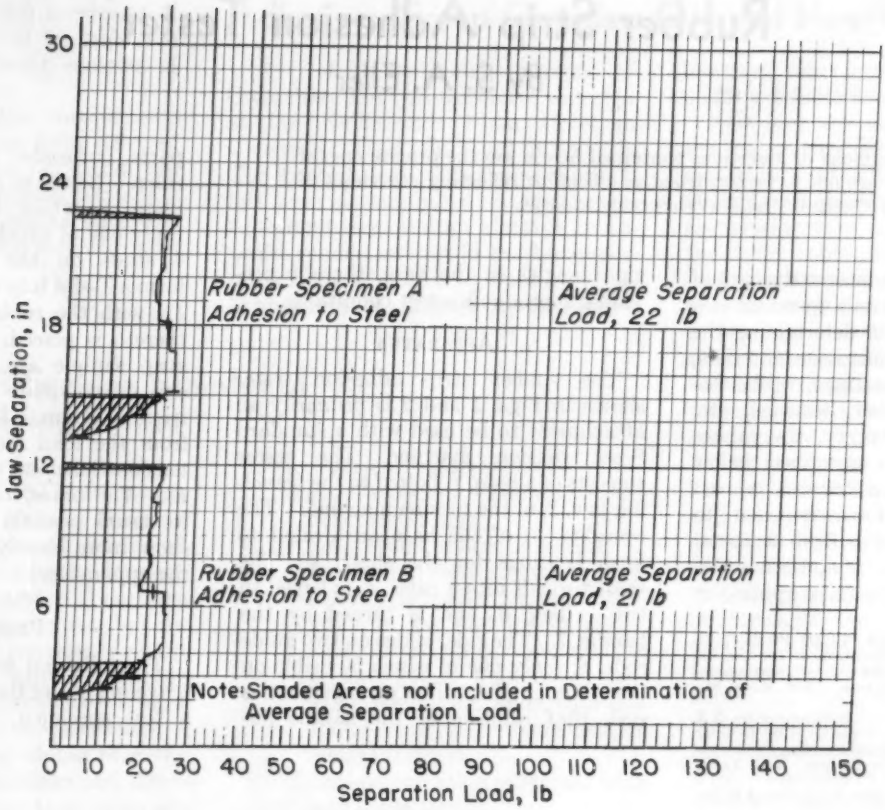

Fig. 3.—Typical Results Obtained Using Strip Adhesion Tester.

metal plate 1⅝ by 6 in. by the thickness of the plate and having a rubber strip 1 by 6 in. and up to ¼ in. thick adhered to the center portion, is placed in the T-slot of the tester. The free end of the rubber strip is secured to the friction clamp and the handle is turned to move the metal plate until the strip is separated from the plate at an angle of 90 deg. The tension machine is then adjusted to operate at a jaw separation speed of 1 in. per min and to draw an autographic plot of adhesive strength. As the traveling jaw moves downward, the rubber strip peels back on the metal plate and tends to change the angle of separation. To compensate for this, as the test progresses, the handle of the tester is turned manually to advance the adhesion plate at a rate sufficient to maintain the 90-deg angle of detachment of the rubber strip as judged by the alignment of the long steel chain. This operation is continued until the entire rubber strip has been separated from the plate. The adhesion tester can thus be used to obtain the adhesive strength of bond of elastomers to a rigid base at a separation angle of 90 deg instead of the 180-deg strip back procedure described in ASTM Tests.[2, 3]

The rate of separation of the rubber strip from the base is actually less than 1 in. per min (jaw separation speed) because of the elongation of the strip after separation from the base. This elongation is directly proportional to the adhesive strength and load-elongation characteristics of the elastomer and inversely proportional to the thickness of the strip. However, as the separation rate never exceeds 1 in. per min, it is believed that the slower separation rates have little effect on the adhesive strength.

Typical curves showing the adhesive strength of bond of rubber strips to metal are shown on Fig. 3. It should be noted that the curves include all values of adhesive strength of the strips along the entire length of test specimen instead of just one or two estimated values such as would be obtained in a dead-weight load type of adhesion test. The average values on the curves were computed, omitting the load build-up and release portions (shown shaded on curves) wherein the rubber specimen is elongating and contracting without separating from the base.

Conclusions

The rubber strip adhesion tester has the following advantageous features:

1. It is a relatively inexpensive attachment that enables the Scott tension machine, which is available in most rubber laboratories, to be used in measuring the adhesive strength of bond of rubber materials to metal.

2. The angle of detachment of the rubber material is accurately maintained at 90 deg to the plane of the base, thereby providing reproducible test conditions.

3. An autographic plot of the adhesive strength of rubber material to the metal plate is obtained over the entire length of specimen, thereby eliminating personal errors and providing a permanent record of the results.

Acknowledgment:

The author wishes to thank C. K. Chatten of the Material Laboratory, New York Naval Shipyard for his encouragement and beneficial suggestions in the preparation of this article.

[2] Method of Test for Peel or Stripping Strength of Adhesives (D 903–49), 1952 Book of ASTM Standards, Part 7, p. 1030.

[3] Method C, Adhesion Strength by Stripping Method (Friction Test), Tentative Methods of Testing Rubber Cements (D 816–51 T), 1952 Book of ASTM Standards, Part 6, p. 362.

Methods of Determining Compression Set of Elastomers at Low Temperatures*,[1]

By Julian I. Belfer[2]

At a meeting in December, 1951, in Detroit, Mich., Section IV-L on Low Temperature Properties of Elastomers of the SAE-ASTM Technical Committee on Automotive Rubber proposed the use of a quick-acting wrench[3] as an alternate for the conventional bolted steel plate device[4,5] in determining the low-temperature compression set properties of elastomers. The Material Laboratory, New York Naval Shipyard, was then authorized by the Bureau of Ships, Department of the Navy, Washington, D. C., to compare the quick-acting wrench procedure with the conventional method.

Apparatus and Specimens

Two types of apparatus were used to maintain a specimen in a compressed state during the conditioning period. Type I consisted of the conventional chromium-plated steel plates fitted with bolts and spacer bars as described in Military Specification MIL-R-900A[4] and in ASTM Tentative Method D 395 – 52 T.[5] The equipment is illustrated in Fig. 1. Type II consisted of an eccentric wrench (No. 10 Vise Grip wrench manufactured by the Peterson Manufacturing Co., Dewitt, Nebr.), mild steel (bare metal) compression plates measuring $\frac{1}{8}$ by 2 by 3 in., and a mild steel spacer ring 0.300 in. high, 2 in. outside diameter, and $1\frac{3}{4}$ in. inside diameter. The latter apparatus is described in two recent reports of the Rock Island Arsenal[6, 7] and is illustrated in Fig. 2. All the metal plates used in the types I and II devices conformed to ASTM requirements for surface roughness.

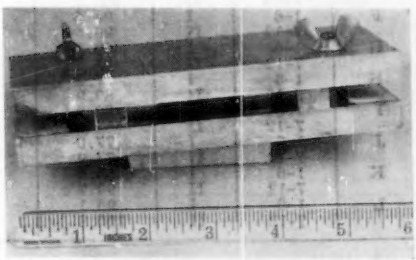

Fig. 1.—Conventional Screw-Type Compression Set Apparatus, Assembled.

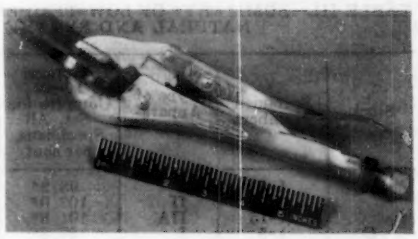

Fig. 2.—Quick-Acting Wrench Compression Set Apparatus, Assembled.

Thirty specimens, each 1.129 ± 0.005 in. diameter by $\frac{1}{2}$ in. thick, were prepared from one slab each of the twelve natural and synthetic rubber stocks, formulated as listed in Table I. Each specimen was washed in water and thoroughly dried before being tested.

Experimental Procedures

The investigation was divided into two distinct phases. In phase I, the specimens were tested in both the conventional (type I) apparatus and the type II apparatus (bare metal plates) in order to compare the two apparatus in general. During this phase of the investigation, it was noted that the compressed specimens would occasionally stick to the bare metal plates of the type II apparatus. To eliminate this source of error, some of the metal plates of the type II apparatus were chromium-plated (type IIA). Phase II of the investigation was then conducted using the type I, type II, and the type IIA apparatus in order to compare the three methods with respect to reproducibility and ease of manipulation.

During the first part of the study (phase I), six specimens each of the twelve stocks were compressed using the type I apparatus. Six additional specimens of each stock were also compressed using the type II apparatus equipped with bare metal plates. All twelve specimens of any one stock were conditioned and tested concurrently to minimize the effect of temperature variations on the material during a test. The specimens were compressed from an original thickness of $\frac{1}{2}$ in. to a thickness of 0.300 in., as fixed by the spacer bars or rings.

TABLE I.—FORMULATIONS OF ELASTOMERS USED.

Formula	Formula Stock No. (Rubber Lab., Mare Island)	Type of Formulation[a]
A.....	E13-92	Smoked sheets (Captax, Tuads, sulfur 0.75 parts)
B.....	E13-173	Smoked sheets (D.P.G., sulfur 3 parts)
C.....	E-162-415	GR-S (Naftolen 510)
D.....	E-162-489	GR-S (tributoxyethyl phosphate, plasticizer SC, dioctyl phthalate, diisobutyl adipate)
E.....	E-194-526	Paracril 26NS90 (Cumar P-10, Bardol)
F.....	E-194-527	Paracril 26NS90 (KP-140, plasticizer SC)
G.....	E-156-315	GR-M
H.....	E-156-290	GR-M (sulfur)
I.....	E-34-104	GR-I (Philblack A 30 parts)
J.....	E-34-105	GR-I (Philblack A 40 parts, dibenzyl ether)
K.....	E-53-15	Thiokol FA (Pelletex (SRF) 40 parts)
L.....	E-53-17	Thiokol FA (Pelletex (SRF) 65 parts, plasticizer SC, tributoxyethyl phosphate)

[a] Only noted in parentheses for brevity are those additives which tend to characterize a formula difference between pairs of otherwise identical formulas.

[6] R. F. Shaw, "Test Methods for Elastomers at Extreme Low Temperatures," *India Rubber World*, Vol. 122, July, p. 421 (1950).

[7] Rock Island Arsenal Laboratory Report No. 1, Project No. TB4-521E, Nov. 8, 1951.

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[1] Presented at a meeting of Subcommittee XXVII on Tests of Resilience of Committee D-11 on Rubber and Rubber-Like Materials held during the Fifty-fifth Annual Meeting of the Society, New York, N. Y., June 25, 1952.

[2] Material Laboratory, New York Naval Shipyard, Brooklyn, N. Y.

[3] Proposed Tentative Recommended Practice for Determining Low Temperature Properties of Automotive Rubber Compounds, revised Dec. 11, 1951.

[4] Military Specification MIL-R-900A, March 23, 1950.

[5] Tentative Methods of Test for Compression Set of Vulcanized Rubber (D 395-52 T), 1952 Book of ASTM Standards, Part 6, p. 126.

Within 5 to 30 min after compression, the twelve assembled jigs holding the compressed specimens of the same stock were placed in a thermally controlled dry ice chamber and subjected to a temperature of −35 F for a period of 94 hr. Two stocks, represented by 24 specimens, were conditioned and evaluated during the same low-temperature conditioning period.

At the end of the 94-hr conditioning period, the specimens were removed consecutively from the respective compression set apparatus while in the chamber and were permitted to recover in the chamber. The thickness of each specimen was measured both 10 sec and 30 min after removing it from the compression plates. These measurements were made using a dial indicator[4, 5] which was located in the low-temperature chamber. The specimens were removed from the conventional type I apparatus by applying a C clamp to the plates before removing the bolts. This clamp was released rapidly after removing the bolts, thus permitting an accurate determination of the 10-sec recovery period.

For the second part of the study (phase II), five specimens each of six different stocks were tested using the type I apparatus, the type II apparatus, and the type IIA apparatus. In these three tests, the 15 specimens of the same stock were exposed and tested at the same time in order to minimize the effect of temperature variations on the material during the conditioning period. As in the first series of tests, the recovered thickness of a specimen was determined in the cold box, the measurements being made both 10 sec and 30 min after releasing the specimens from the plates.

Results

The 10-sec and the 30-min compression set values were calculated from the observed data using the equation as given in Specification MIL-R-900A and ASTM Method D 395–49 T:

$$C = \frac{t_0 - t_1}{t_0 - t_s} \times 100$$

where:

C = compression set, per cent,
t_0 = original thickness of specimen,
t_1 = thickness of specimen after removal from clamp, and
t_s = thickness of steel spacer.

The average and range of values of compression set for phases I and II are presented in Tables II and III, respectively. In some instances, specimens compressed between the bare metal plates of the type II apparatus were found to stick to the metal and had to be pried loose before making the 10-sec recovery measurement.

TABLE II.—SUMMARY[a] OF LOW-TEMPERATURE COMPRESSION SET PROPERTIES OF NATURAL AND SYNTHETIC ELASTOMERS, PHASE I.

Stock	Specimen Numbers	Type of Apparatus[b]	Average, 10-sec Compression Set, All Specimens, per cent	Range, 10-sec Compression Set, Individual Determinations, per cent	Average, 30-min Compression Set, All Specimens, per cent	Range, 30-min Compression Set, Individual Determinations, per cent
A	1–6	I	96.3	95.4–98.0	95.4	94.4–96.9
	7–12	II	102.7	101.0–103.6	102.3	101.0–103.6
B	1–6	I	86.2	82.6–89.1	79.1	73.7–82.6
	7–12	II	92.8[c]	88.4–98.4	88.9[d]	81.5–98.4
C	1–6	I	84.8[c]	83.9–85.3	60.2[d]	58.9–61.6
	7–12	II	89.5	88.9–90.0	59.5	57.9–61.1
D	1–6	I	75.8	75.3–76.3	38.5	37.9–38.8
	7–12	II	76.3	74.9–78.0	35.2	33.7–36.6
E	1–6	I	98.2[d]	97.9–98.5	97.6	97.4–98.0
	7–12	II	102.1	101.3–102.6	101.6	101.0–102.1
F	1–6	I	94.5	94.2–94.9	76.7	75.7–77.6
	7–12	II	99.5[d]	98.9–100.0	81.4	80.3–82.6
G	1–6	I	89.8[d]	87.8–91.9	50.2	48.5–51.8
	7–12	II	85.6	83.3–86.7	44.8	42.3–47.9
H	1–6	I	87.2	84.3–88.8	42.7	41.4–44.7
	7–12	II	89.9	87.1–93.2	41.5	38.5–42.8
I	1–6	I	82.3	81.5–83.2	33.8	33.2–35.0
	7–12	II	84.0	82.8–85.4	32.7	31.6–33.3
J	1–6	I	77.0	76.2–77.8	26.1	25.3–27.8
	7–12	II	77.9	73.5–80.0	25.0	23.3–27.2
K	1–6	I	89.5	89.0–90.0	77.1	76.5–77.7
	7–12	II	93.7	89.9–96.5	78.5	76.3–79.8
L	1–6	I	96.1	95.8–96.3	95.7	95.2–96.3
	7–12	II	100.8	99.5–101.6	99.7	98.4–101.1

[a] For the sake of brevity the individual specimen values obtained by the author have been averaged and their range shown.
[b] Type I apparatus was the conventional one with chromium-plated steel plates; type II apparatus consisted of a quick-acting, adjustable wrench with bare metal plates.
[c] Two values omitted because of experimental accidents which invalidated the data.
[d] One value omitted because of an experimental accident which invalidated the data.

TABLE III.—SUMMARY[a] OF LOW-TEMPERATURE COMPRESSION SET PROPERTIES OF NATURAL AND SYNTHETIC ELASTOMERS, PHASE II.

Stock	Specimen Numbers	Type of Apparatus[b]	Average, 10-sec Compression Set, All Specimens, per cent	Range, 10-sec Compression Set, Individual Determinations, per cent	Average, 30-min Compression Set, All Specimens, per cent	Range, 30-min Compression Set, Individual Determinations, per cent
A	1–5	I	98.2[c]	97.9–98.5	97.3[c]	96.8–98.5
	6–10	II	102.0[c]	101.0–103.0	101.8	101.0–102.6
	11–15	IIA	101.8[c]	100.5–103.5	100.8	100.0–102.5
C	1–5	I	87.8[c]	85.5–92.6	67.4	64.8–76.0
	6–10	II	90.4	88.7–91.8	66.3	63.4–67.9
	11–15	IIA	90.2	89.2–91.7	65.2	64.1–67.9
D	1–5	I	77.1	76.2–77.7	43.4	42.0–45.5
	6–10	II	82.0	79.9–83.2	42.4	41.8–42.7
	11–15	IIA	79.6	78.4–81.7	40.7	30.7–42.4
F	1–5	I	93.1	92.3–93.9	77.3	77.0–77.7
	6–10	II	97.9	96.3–99.5	81.1	79.5–82.4
	11–15	IIA	97.8	96.9–98.5	78.6	77.3–80.1
G	1–5	I	81.2	76.8–83.2	46.4	43.7–49.0
	6–10	II	89.8	87.6–91.6	52.1	49.7–54.5
	11–15	IIA	89.4	87.2–90.4	49.5	48.2–50.8
K	1–5	I	90.3	89.8–91.0	76.6	75.5–78.3
	6–10	II	93.2	91.9–95.0	79.7	78.4–81.2
	11–15	IIA	93.4	92.6–93.8	78.1	76.7–79.0

[a] For the sake of brevity the individual specimen values obtained by the author have been averaged and their range shown.
[b] Type I apparatus was the conventional one with chromium-plated steel plates; type II consisted of a quick-acting, adjustable wrench with bare steel plates; type IIA consisted of a quick-acting, adjustable wrench with chromium-plated steel plates.
[c] One value omitted because of an experimental accident which invalidated the data.

Discussion and Conclusions

Statistical analysis of the individual data which have been summarized in the tables indicates that the procedure for determining the low-temperature compression set properties of elastomers utilizing a quick-acting wrench generally yields 10-sec values of compression set that are significantly higher than those obtained by the conventional method. However, the differences between the 30-min values do not appear to be significant, the values obtained using the type I apparatus being either higher or lower than those obtained using the type II equipment. The degree of precision was almost equal regardless of the type of apparatus used. In this respect, there is no preference for one type of equipment over the other.

As shown in Table IV, the results obtained in the second set of tests place the six elastomer stocks in the same order of merit regardless of the type of compression set apparatus used in the tests. The same order of rating was also obtained for the preceding six stocks in both sets of tests when using the type II apparatus with bare metal plates. However, the order of rating was different in both sets of tests when using the type I (conventional) apparatus. Since each set of tests was made on different days, all other factors being

the same, it would appear that there is better reproducibility of results for the quick-acting wrench device than for the conventional apparatus.

Also, the quick-acting wrench device was found to be easier and quicker to assemble and manipulate. The same advantages were also apparent when disassembling in the cold box. This may account for the somewhat higher values of 10-sec compression set using the type II device because there was little, if any, lapse of time between disassembly of the plates and starting the stop watch for the 10-sec recovery reading.

Occasionally the compressed specimens would stick to one or both bare metal plates of the type II apparatus. This difficulty was not encountered when using the chromium-plated plates.

A possible improvement in the type II apparatus would be to braze the compression plates to the jaws of the quick-acting wrench. This would facilitate assembling the device and would provide a quick, simple means of compressing and releasing the specimen.

In conclusion, the quick-acting wrench compression set apparatus was found to be superior to the screw type device with respect to duplication of compression set ratings, accuracy of short time (10-sec) compression set values, and ease of manipulation. The adoption of the type II apparatus using chromium-plated plates may require re-evaluation of specification requirements based on the higher 10-sec recovery data obtained using this apparatus.

TABLE IV.—RATINGS OF VARIOUS ELASTOMERS ON BASIS OF COMPRESSION SET PROPERTIES DETERMINED BY DIFFERENT METHODS.

PHASE I

Rating[a]	Apparatus Type			
	I		II Bare Metal	
	10 sec	30 min	10 sec	30 min
1.	D	J	D	J
2.	J	I	J	I
3.	I	D	I	D
4.	C	H	G	H
5.	B	G	C	G
6.	H	C	H	C
7.	K	F	B	K
8.	G	K	K	F
9.	F	B	F	B
10.	L	A	L	L
11.	A	L	E	E
12.	E	E	A	A

PHASE II

	I		II Bare Metal		IIA Chromium-Plated	
	10 sec	30 min	10 sec	30 min	10 sec	30 min
1.	D	D	D	D	D	D
2.	G	G	G	G	G	G
3.	C	C	C	C	C	C
4.	K	K	K	K	K	K
5.	F	F	F	F	F	F
6.	A	A	A	A	A	A

[a] Lowest numerical rating corresponds to lowest compression set.

Acknowledgment:

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Relation Between Bond and the Surface Physics of Masonry Units—an Abstract

By John C. Thornton[1]

EDITOR'S NOTE.—The following article is a rather comprehensive abstract of a paper presented before the American Ceramic Society at its Fifty-fourth Annual Meeting in Pittsburgh, Pa., on April 29, 1952. The paper was presented again before a large group during the ASTM Committee Week meetings in Detroit, Mich., and was published in full in the April, 1953, issue of the *Journal* of the American Ceramic Society. Because of the particular interest of this subject to many ASTM members this abstract was prepared for the ASTM BULLETIN.

WHILE the author and his colleagues were doing research work with mortars, it was noticed that many brick had high capillarity on rough or sanded surfaces and little or none on others. This led to bond tests during which it became evident that there was a relation between the kind of surface on a unit and the amount of bond. Further experiments with chimneys or wells showed that (1) leakage and extent of dye penetration coincided closely with the previous laboratory bond tests, (2) there was excellent bond and practically no dye penetration with smooth brick, which had little or no capillarity, (3) bond decreased and dye penetration increased according to the surface, and (4) as the capillarity of the surface increased, the bond decreased. It became apparent that while there are differences in mortars in respect to bond, these differences are rather small as compared to the effect caused by the surfaces of masonry units.

BOND TESTS

Up to this time the author had thought that when good bond in head joints was not achieved, the capillary action of the masonry unit and also of the mortar would help water through the wall. He had surmised by observation on the job that the voids on the brick were not filled; to determine, therefore, how far this went, differently finished brick were laid and allowed to set for 4 hr. The test was made with much better workmanship than is usually found on the job.

The mortar used for this experiment was a 1:1:6 mix, using portland ce-

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ment, a pressure-hydrated type-S lime, and pit sand (mortar sand) conforming to ASTM specifications. A ½-in. bed of mortar was laid and a smooth surface brick was embedded in it; thereafter mortar was placed on the end of each brick with a trowel and precautions were taken to make sure that the end was covered completely with at least ¾ in. of mortar. The brick was then embedded in the bed mortar and pushed against the adjoining brick so that the mortar at the head joint squeezed out enough to leave a ⅜-in. joint. This procedure was followed with each brick to make sure that each head joint was properly filled. After 4 hr each brick was knocked loose with a hammer and tapped until the mortar fell away from the brick.

The results showed that smooth, iron-spot brick had an excellent bond when laid either damp or dry. This appeared to bear out the permeability tests with chimneys, which showed that tighter walls were obtained with smooth brick. A vertically scored brick showed clearly that the mortar does not get into the scores but has a good bond on smooth sections, though it showed considerable difference in bond between the buttered and backup ends. A rug-texture brick had had leakage in the chimney tests, indicating that the mortar does not fill all the voids and did not bond to the rough areas. A matt-texture brick had a much better bond on the buttered end; the mortar does not fill the voids. A sand-mold brick laid dry showed very poor bond on one brick and good bond on another; these brick vary considerably. A sanded brick laid dry shows extremely poor bond.

It was also noted that when a smooth surface brick is laid next to a rough brick, the mortar breaks away from the rough brick and sticks to the smooth. With smooth brick of low suction, a good bond is obtained when the brick are laid dry; moistening does not help and can reduce the bond.

To determine the bond after setting for four days instead of 4 hr, five bricks were tested. We know, of course, that bond does increase a certain amount with age. This experiment and later tests showed that the 4-hr test gave a good indication of bond.

The next experiment was conducted to determine the effect of waterproofing on capillary action and bond. The heads of brick were treated with waterproofing and the brick were allowed to dry. Both a silicone and a wax-base waterproofing product were used and comparison was made between the waterproofings and between the treated and untreated surfaces. The treated ends were tested for capillary action and it was found that this treatment stopped the action entirely on all finishes. The brick were then tested for bond as before. The treated half of each brick end showed a much better bond than the untreated half. There was little or no difference between waterproofed ends, both showing good bond.

The author next tried to determine what effect surface texture had on drawing water out of a mortar joint, knowing, of course, that if the water is drawn out of the mortar, as in the case of a common brick of high suction, a good bond is not achieved. The results show rather clearly that some bricks do draw water out of joints, as much as 1 in. for a period of at least 2 hr. It also showed that other brick are not very bad in this respect.

Vertically scored brick are not helped by wetting. There is a lack of bond only because the mortar does not get into the scores. It is about the same with matt-texture brick. Moistening helps a little on some rugs and, as with matts, the wetting helps with certain kinds of roughness but not with others. Results on sanded brick are astonishing; in the case of the two sand-mold brick, moistening increases the bond as much as 95 per cent.

Chimney Experiments

The chimneys were approximately 4 ft square, 8 in. thick, and were 6 courses high (4 different brick in each chimney). There were no headers. Joints were full and the best workmanship was used throughout. The joints between the different panels were laid in caulking compound so that the water could not get from one panel to another. All the joints were concave-tooled; just before introducing the water, the raked-out joint at the concrete floor was well caulked. At the end of 30 days, water was introduced into each chimney and an accurate record of each leak was kept. Only one chimney was tested at a time. There were 250 leaks in eight chimneys, but there was not a single leak with any mortar with the smooth iron-spot brick. At 45 days, dye was put in the water and the chimneys filled again. There were fewer leaks this time, which showed that if a building could be submerged, leakage would be reduced materially. Water furthers the chemical reaction and tends to produce a better bond.

Discussion

The difference between well-burned brick and the underburned brick is tremendous. Better bond was obtained with the well-burned brick and the loose sand fell off much more easily.

In the case of a sand-mold brick, it is found that many are used near where they are made with little difficulty. The answer to this seems to be that it is the custom in that locality to use a much wetter mortar than masons elsewhere will use.

It can now be seen how the weather can affect bond. On damp days there may be enough moisture on certain bricks to cut down the capillary action. Dry, windy days will increase it, reducing bond strength.

The brick do vary, and it has been shown definitely that when they are clean, good bond is obtained; when there is sand, the bond is poor.

With respect to efflorescence, it is the symptom of a disease. Moisture must get into a wall and then come out to produce it. Our first effort should be to try to keep moisture from getting in.

Conclusions

To review what seems to be apparent from the research work to date:

1. Mortar does not get into the voids of rough brick, regardless of whether the voids are large as in rugs or small as in sand-finish brick.
2. Capillary action of some brick surfaces draws moisture from the mortar before perfect bond can take place.
3. Loose or removable sand from any faces of brick raises capillarity and reduces bond considerably, regardless of whether the sand is coarse or very fine.
4. For rough brick a mortar is needed of a sufficiently high workability to fill the voids on the face of the brick and sufficient water retention to nullify the surface capillarity.
5. In head joints the poorer joint is the backup joint. In bed joints the poorer joint is the contact with the brick above, that is, the first contacts are the best, usually by a high percentage.
6. Time in tooling is important. Tooling too quickly breaks the bond.
7. Wetting mortar boards or use of metal or treated wood boards should be advocated. The water should be kept in the mortar as long as possible.
8. Some brick of low suction require wetting to obtain proper bond. Manufacturers should test the brick and not be hesitant about advising wetting if this is found desirable.

It is not advised stopping the use of any certain finish although it is believed that it is necessary to modify some finishes, such as rough and deeply undercut rugs, rough matts, and heavily sanded brick, and to eliminate loose sand on any brick.

A New Degreasing Evaluation Test: The Atomizer Test*

By Henry B. Linford[1] and Edward B. Saubestre[1,2]

PROJECT No. 12, sponsored by the American Electroplaters' Society, entitled: "Cleaning and Preparation of Metals for Electroplating," was established at Columbia University in the fall of 1949. It was decided at the outset to concentrate on one phase of this problem, namely, degreasing; however, it was obvious from the literature that the entire field needed a critical survey with definite recommendations as to proper testing procedure.

So far, considerations of inorganic films, including oxide films, have not been emphasized, and it can truthfully be stated that they have been ignored except where the presence of oxide would affect either the soiling of the panel or the operation of the degreasing evaluation test under consideration. At the outset, it was decided that mild matte surface steel would be a satisfactory material to use in this study and therefore, all results reported have been on that basis material.

Specimen Design

Reproducible cleaning and soiling procedures could not be developed using rectangular panels drilled near the top to allow inert hooks to be employed for handling, as previous investigators have done, because of nonuniform drainage from the surface. Therefore, a new sample design was evolved (Fig. 1) consisting of a central rectangular portion 2 in. wide and 3 in. long, with a tongue $\frac{1}{2}$ in. wide and approximately 3 in. long at the top, and a triangular section at the bottom. The triangular section effectively eliminates the ridge or roll of fluid that normally forms at the bottom of a rectangular plate. The tongue was left in order to enable the operator to handle the specimen without contamination. Contamination from handling could be still further reduced by introducing an S bend in the tongue, thereby making it impossible for any condensates, gathering on the brass clips used to support the specimen, to flow down over the test panel surface. All results are reported on the central 2 by 3-in. rectangular area. These panels were cut with a precision shear,[3] which leaves edges free of burrs. Cleaning and rinsing were carried out in containers suitably designed for overflow in order that the surface of the liquid might be skimmed free of oils or greases. Since this project was dealing primarily with degreasing evaluation, no extensive study of cleaner formulations has been made, and for the purposes of this research the following cleaner was arbitrarily chosen as a representative alkaline degreasing bath:

Sodium orthosilicate (Na_4SiO_4), 85 per cent by weight
Sodium carbonate (Na_2CO_3), 10 per cent by weight
Wetting agent (Nacconol-Nr), 5 per cent by weight
Used in a concentration of 6 oz per gal (45 g per liter)

[3] Di-Acro Notcher, O'Neil-Irwin Mfg. Co., Lake City, Minn.

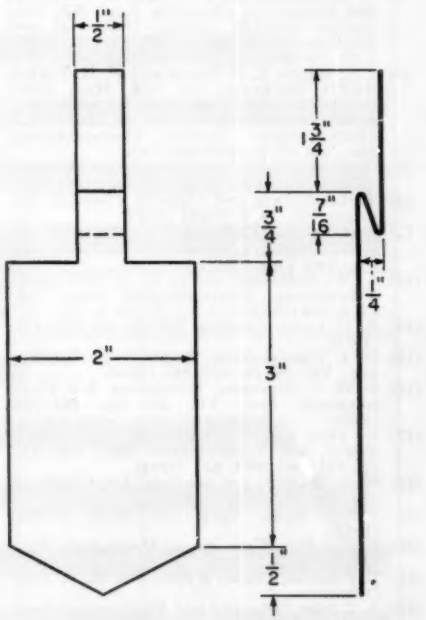

Fig. 1.—Shape of Sample.

Cleaning and Soiling Procedure

The procedure followed in cleaning and soiling is illustrated in Table I.

TABLE I.—SOILING AND CLEANING PROCEDURE.

Process	Temperature, deg Cent.	Time, min
Precleaning		
Waste cleaner..	100	15 soak, 3 overflow
Water rinse....	Room	3 soak, 2 overflow
Pickling		
20 per cent HCl dip.....	Room	2
Water rinse....	Room	2
Solvent treatment		
CH_3OH dip....	Room	2
C_6H_6 dip.....	Room	2
Soiling		
Oil dip.....	Room	5
Drainage in air.	Room	20
Cleaning		
Alkaline cleaner.....	Variable	Variable soak, 3 overflow
Water rinse....	Room	3 soak, 2 overflow
Preparation for Testing		
1 per cent HCl dip.....	Room	1
Water rinse....	Room	2 overflow

In the course of our work of studying the currently used degreasing evaluation tests, it became obvious that the wettability type of test should be the simplest, and therefore, considerable attention was given to the study of existing wettability tests. In the course of this study, it was observed that areas which appeared to be clean by the water-break test would appear soiled if the specimen were allowed to dry and then sprayed with water. It should be recalled that the spray-pattern test, as developed by S. Spring (1),[4] is based on the water-break test, in which the panel is allowed to drain for a given period of time. The areas from which the water film has broken receive a coating of water droplets. If, however, the panel is dried completely and then sprayed, it was shown that, if the specimen were clean, a continuous film would form. However, if the specimen were contaminated, the surface would be covered with a series of droplets. The details of the test, as developed, are as follows.

[4] The boldface numbers in parentheses refer to the list of references included in Table II.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

* This paper is based on a series of publications appearing in *Plating* (2); presented at a meeting of Committee D-12 on Soaps and Other Detergents, March, 1953. It was prepared as contribution No. 26 from the Chemical Engineering Dept., Engineering Center, Columbia University, New York, N. Y.

[1] Columbia University, New York, N. Y.
[2] Present address: Sylvania Electric Products, Inc., Flushing, N. Y.

The Atomizer Test

The equipment consists of an ordinary atomizer.[5] The bulb is removed and the atomizer connected to the compressed air line. The air enters a 5-gal carboy, half filled with distilled water, and goes thence to a tube filled with glass wool and an empty 2½-liter bottle which acts as a surge vessel. Between the surge vessel and the atomizer, a glass tee is installed to allow a mercury manometer to be connected into the line. The solution used may be distilled water. However, it has been found that for the purposes of recording results it is desirable to add a dye.[6]

After the cleaning and rinse, the panels are hung in a vertical position in air at room temperature and allowed to dry completely in the central 2 by 3-in. portion of the panel. This normally requires 3 to 5 min. It is not necessary to wait for the water to evaporate from the lower triangular portion of the panel. Since, in general, oils do not spread on the water-wetted surface, and the elapsed time after drying is, in general, very short, only minor difficulties arise from the spreading of the oils during this portion of the test. The spraying is done at a pressure of 18 ± 3 in. of mercury, at a distance of 2 ft. The total time for the spraying is approximately 30 to 45 sec. If the spraying time is too short, the contrast between dirty and clean area is vague. If the spraying time is excessive, water droplets build up and flow down the panel surface. This obscures the pattern. A little experience will indicate the desired time. The pattern may then be sketched on cross-section paper.

A better method is to proceed as follows: as soon as spraying has been completed, dry the panels with a heat lamp placed about a foot away. This "freezes" the pattern for permanent recording, staining with a blue dye wherever there are water globules present. Where the uniform thin film forms, the dye is too diluted to leave much stain behind upon drying. The oil will spread during this operation as soon as the water globules have been evaporated, but this in no way affects the dye pattern. Take a pencil and outline either the clean areas or the soiled areas, depending upon which is predominant, and then, by means of a pantograph with a 2 × magnification, record these areas on paper for a permanent record.

Comparison of Tests

The fundamental difference between the atomizer test and the water-break test is that the atomizer test depends upon the advancing contact angle of the water droplet, whereas the water-break test depends upon the receding contact angle of the water film. It has been clearly demonstrated in the literature that such a hysteresis exists (2). Any person observing water droplets rolling down a window pane will recall that the droplet does not maintain a symmetrical form, but that the advancing angle is considerably greater than the receding angle. From this consideration, it becomes obvious that the atomizer test should be superior.

There is another phenomenon that occurs with the water-break test that also deserves mention, namely the bridging effect. A small isolated droplet of oil on the surface of an otherwise clean metal will often, when flooded with water, not show any water-break due to the bridging effect in which the film remains continuous over this droplet. However, in the atomizer test, such a droplet would retard the advance of spreading of a water droplet, and would therefore, show up as a soiled area.

The various degreasing evaluation procedures available are tabulated in Table II. In our research work, we have compared the atomizer test quantitatively with the fluorescent dye test, spray-pattern, ferricyanide, and copper dip tests. It must be borne in mind that the spray-pattern test is simply a quantitative interpretation of the water-break test, and that the gravimetric test does not fit into the same pattern as these since it does not in any way give a measure of the percentage of the clean area, while the other miscellaneous tests in Table II are qualitative only. We have not investigated the radioactive tracer technique, feeling that at the present time the cost of the test is such that the average plating shop could not afford to install it.

Table III and Fig. 2 give an indication of the cleaning index (that is, the percentage of the panel area which appears clean) as measured by these various tests on specimens prepared in an identical manner as tabulated in Table I. It must be borne in mind that oil residues remaining after alkaline cleaning are in the form of discrete droplets. To determine quantitatively the ultimate sensitivity of these tests, the soil must be present as a continuous thin film. To do this, the Devaux method was employed (3). This method consists of evaporating solvents

TABLE II.—DEGREASING EVALUATION TESTS.

Type and Name	References
Wettability	
Water-break	1,3,4,5,6,7
Spray-pattern	1
Atomizer	2
Tracer	
Fluorescent	8
Radioactive	9
Chemical	
Copper replacement	5,6,10,11
Potassium ferricyanide paper	6,12,13,14,15,16,17,18
Miscellaneous	
Gravimetric	5,19,20
Residue-pattern	5
Cloth wipe	21
Solvent residue	22
Carbonaceous residues	23,24

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[5] De Vilbiss No. 251 bulb atomizer of 15-ml capacity.

[6] 0.1 per cent Niagara Sky Blue 6B conc.-dye (National Aniline and Dye).

TABLE III.—SENSITIVITY OF DEGREASING EVALUATION TESTS.

Test	Cleaning Index		
	Lard Oil 3 min at 70 C	Lard Oil 10 min at 70 C	Mineral Oil 3 min at 40 C
Atomizer	9.5	23.1	41.0
Fluorescent dye	51.7	85.2	83.9
Spray-pattern (water-break)	84.3	94.4	95.6
Potassium ferricyanide	85.6	96.6	98.4
Copper sulfate dip	88.7	98.3	98.3

containing known amounts of oil on a given surface area. By progressively decreasing the quantity of oil deposited on the surface, it is then possible to determine the minimum concentration, in grams per square centimeter, that can be detected. The results of this study are given in Table IV and Fig. 3. These results show that the atomizer test is comparable to the radioactive tracer test in sensitivity, and that these two tests are clearly superior to all others.

In comparing the radioactive tracer and atomizer tests, the former is found to have one major advantage. The limit of sensitivity can be pushed back indefinitely by improved techniques, as the test has practically no inherent limit of sensitivity, something which is not true of the atomizer test. The atomizer test has four major advantages: (1) it is less expensive, (2) it may be conducted by persons with little technical training, (3) it can be used with any oil already present on the test piece, and (4) it readily reveals the distribution of oil on the test panel.

TABLE IV.—TEST SENSITIVITY.

Test	Lard Oil, g per sq cm	Mineral Oil, g per sq cm
Atomizer	6.5×10^{-8}	3.0×10^{-7}
Water-break (spray-pattern)	6.5×10^{-7}	9.0×10^{-6}
Fluorescent dye	2.5×10^{-8}	4.0×10^{-5}
Copper sulfate dip	3.0×10^{-8}	.....
Potassium ferricyanide	3.0×10^{-8}	1.0×10^{-4}

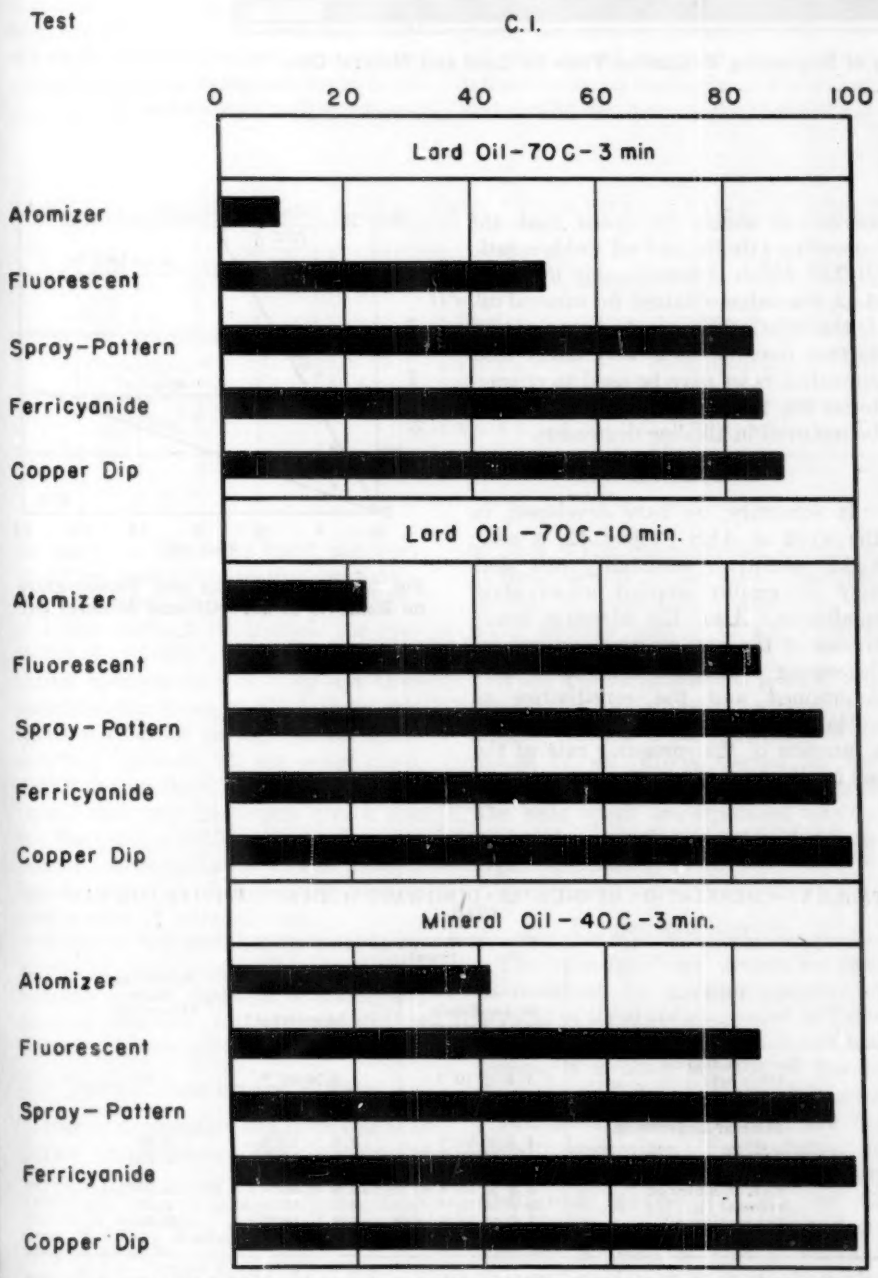


Fig. 2.—Cleaning Index Results for Various Degreasing Evaluation Tests.

As would be expected, sensitivity is a function of the polish. Specimens with a surface roughness rms value of 33 (matte) were compared with polished specimens[7] having an rms value of 0.66. The polished specimens showed a sensitivity, for the most part, between two and three times greater than the matte surface for both lard and mineral oils.

In conducting the atomizer test, it is necessary to allow the panel to dry. While the metal is still wet with water, oil droplets will not spread appreciably. However, as soon as the panel is dried, spreading may take place. Therefore, one possible explanation for the difference in sensitivity of the atomizer test as compared to the water-break test could be due to the fact that the residual oil droplets spread, and therefore cover a larger area. To check this point, oil spreading rates were determined using a regular matte steel surface, and the rate of change of the diameter with respect to time was determined. Since it is practically impossible to measure the diameter of the drop immediately on placing it on the metal surface, it is necessary to compare the diameter at any given time with the diameter after any fixed reference time. The value of this reference time is purely arbitrary, and 9 min. was chosen since, by measuring the diameter after 9 min, all irregularities on spreading rates, due to the manner in which the droplet is applied to the metal surface, have disappeared. Very good reproducibility on spreading rates can be obtained if the rate is measured as a ratio of diameter of the drop at any given time to the diameter at 9 min. It was found very convenient to compare the diameter of the droplet after 150 min to that at 9 min.

It is interesting to note that even in the case of the rapid-spreading oils, such as mineral oil, the change in diameter of the droplets is not nearly enough to account for the difference in sensitivity between the atomizer test and the water-break test. However, some very interesting facts are brought out in Table V and Fig. 4. In this table, oils are divided into three types: "non-spreading," "partial spreading," and "spreading," and the sensitivity, as measured by the spray-pattern variation

[7] These specimens prepared through the courtesy of E. T. Candee, Lea Manufacturing Co., Waterbury, Conn.

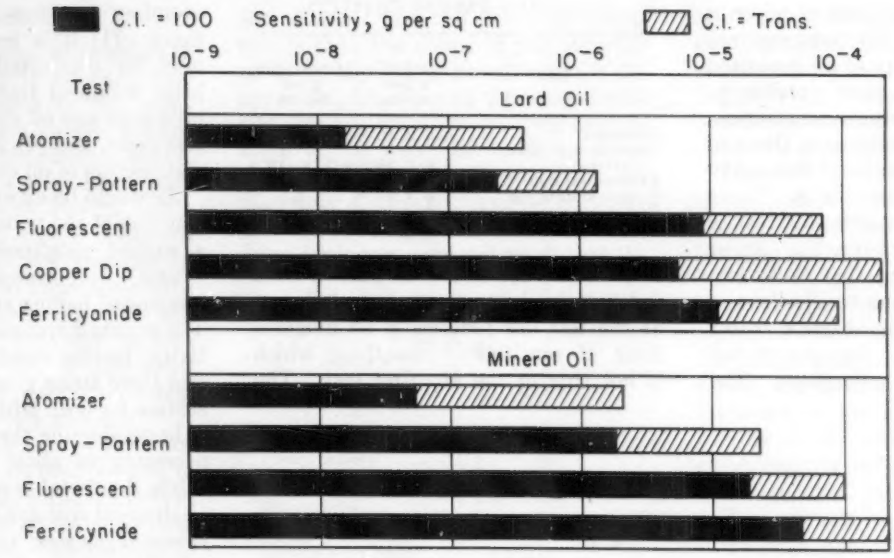
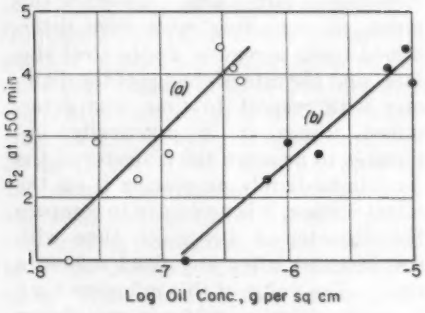


Fig. 3.—Sensitivity of Degreasing Evaluation Tests for Lard and Mineral Oils.



Curve a—Atomizer test.
Curve b—Water-break test.

Fig. 4.—Correlation of the Sensitivity of Wetting Tests with Oil Spreading Rates.

of the water-break test and the atomizer test, is given. From these data, it is possible to estimate the sensitivity of a wettability test by observing the spreading rate of the soiling oil.

Sufficient work has not been done to correlate ease of cleaning with spreading rates. However, early in this project a study was made of the cleaning conditions which would be required in order to obtain partially cleaned panels when using mineral oil and lard oil. The results shown in Fig. 5 indicate that the lard oil is much more difficult to remove than mineral oil. In fact, mineral oil apparently is being displaced primarily by the immersion and removal of the specimens from the various cleaning and rinsing baths, thus accounting for the independence of the time factor, while, on the other hand, lard oil is much more difficult to remove. It should be noted that the spreading rate for lard oil yields a ratio of 2.31 which is considerably less than 4.42, the value obtained for mineral oil. If this relationship can be borne out by further research, it is very likely that spreading rates may be used to characterize the facility with which oils may be removed in alkaline degreasers.

Summary

In summary, we have developed, in the work of AES Project 12, a new, highly sensitive, wettability test that may be readily applied under shop conditions. Also, the absolute sensitivities of the now existing commercial degreasing evaluation tests have been determined and the sensitivities of wettability tests have been shown to be a function of the spreading rate of the soil in oil.

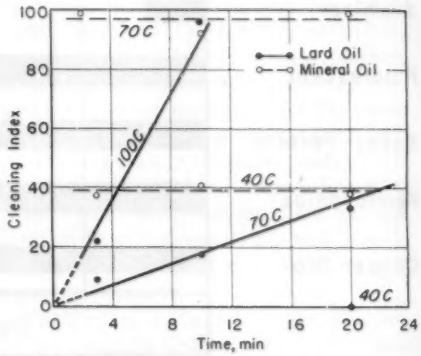


Fig. 5.—Effect of Time and Temperature on Removal of Lard Oil and Mineral Oil.

TABLE V—CORRELATION OF OIL SPREADING RATE WITH SENSITIVITY FOR VARIOUS OILS.

Oil Type	Sensitivity, g per sq cm		Spreading Rate Observed[a]
	Water-Break (Spray-Pattern)	Atomizer	
Nonspreading oil			
Oleic acid	1.5×10^{-7}	1.8×10^{-8}	1.00
Partial spreading oil			
Lard oil	6.7×10^{-7}	6.7×10^{-8}	2.31
Mineral-lard cutting oil	1.0×10^{-6}	3.0×10^{-8}	2.88
SAE 50 motor oil	1.8×10^{-6}	1.2×10^{-7}	2.72
Spreading oil			
SAE 10 motor oil	6.3×10^{-6}	3.8×10^{-7}	4.09
Mineral oil	9.0×10^{-6}	3.0×10^{-7}	4.42
101 cutting oil	1.0×10^{-5}	4.3×10^{-7}	3.86

[a] Values are for R_9 at 150 min; that is the ratio of the area of an oil drop 150 min after application to a metal surface and its area 9 min after application. All values for matte surfaces at 26 to 29 C.

Analysis of Synthetic Detergents by Infrared Absorption Technique

By Philip Sadtler[1]

A NUMBER of "wet methods" are in common use for the examination of synthetic detergents. These methods are generally based upon the analysis of soap products or related determinations, and therefore great care must be exercised to avoid erroneous interpretation of such results. The chemical structures of synthetic detergents differ so widely that they may not easily be separated between various extraction phases, being soluble in both aqueous and nonaqueous media, whereas soaps, on the other hand, are very easily separated from other materials. Such difficulties point to the desirability of other methods of analysis for synthetic detergents. The regular qualitative methods may or may not have identified the group to which these synthetic detergents belong. Infrared absorption methods, on the other hand, definitely identify the type of compound and very frequently give a clue for the exact identification of the compound. Determination of the molecular weight will often help to resolve ambiguities of infrared data.

Many of the standard tests made on synthetic detergents, such as moisture, volatile matter, free acid or alkali, and alcohol insoluble matter, are still of value.

Preparation of the Sample

Proper preparation of the sample is of prime importance. The amount of sample, either liquid or solid, to be placed in the beam of infrared light should be in the order of 0.01 to 0.4 mm thick. If the sample is a liquid, it should be placed in a cell having a known distance between the windows, or it may be pressed between salt windows. Should the sample be a solid, it may be dispersed in mineral oil of medicinal grade, or in two solvents. The two solvents generally used are carbon tetrachloride for the region of 2 to 7.5 μ, and carbon disulfide for the range of 7.5 to 16 μ. The concentration should be in the order of 10 per cent. Samples should be essentially anhydrous, as water absorbs heavily in the infrared region.

When a mixture of solids is used, it is frequently advisable to extract the organic fraction from the inorganic by means of anhydrous alcohol, carbon tetrachloride, or similar compounds. The salts which are separated may be analyzed according to standard inorganic procedure.

Functional Groups

The main functional groups are easy to recognize on infrared spectra. A number of these are illustrated in Table I. Having identified these functional groups, it is often possible to discern the nature of the synthetic detergent.

Minor variations, however, are not always descernible. For instance, infrared absorption does not generally distinguish between C_{14}, C_{16}, or C_{18} chain lengths; they will all appear very similar. A band at 13.8 μ, which is known as "CH wagging," from the hydrocarbon chain, is a characteristic of these chains.

Certain groups of bands also are indicative of particular organic groupings. A series of the combinations is given in Table II. In some cases these bands have characteristic shapes. Take, for example, a glyceride ester such as is found in cottonseed oil. In this case the shape of the bands between 8 and 9 μ are very characteristic (illustrated in Fig. 2), as well as the ratio of the bands at 5.7, 6.8, and 7.3 μ.

TABLE I.—IDENTIFICATION OF ORGANIC GROUPS FROM INFRARED WAVELENGTH ABSORPTION BANDS.

Functional Group	Wavelength, μ
OH	2.9
NH, NH_2	3.0 to 3.1
CH, CH_2, CH_3	3.2, 3.3, 3.4, 6, 7.2, 9
CO in esters	5.7 to 5.8
CO in fatty acids	5.9
CO in soap	6.1
CO in amides	6.1
NH in amides	6.3 to 6.4

TABLE II.—IDENTIFICATION OF ORGANIC GROUPS FROM GROUPS OF INFRARED WAVELENGTH ABSORPTION BANDS.

Functional Group	Wavelength, μ	Illustrated in
Ethylene oxide condensation	2.9, 8.0, 9.0	Fig. 1
Glyceride esters	5.7, 6.8, 7.3, 8.1, 8.6, 8.9	Fig. 2
Esters	5.7, 8.6	...
Cationic amines	3.0, 6.0, 6.4, 6.8, 7.3	...
Sulfonic	8.3 to 8.5, 9.2 to 9.6	Fig. 3
Hydrocarbon	3.4, 6.8, 7.3	Fig. 4

Spectra

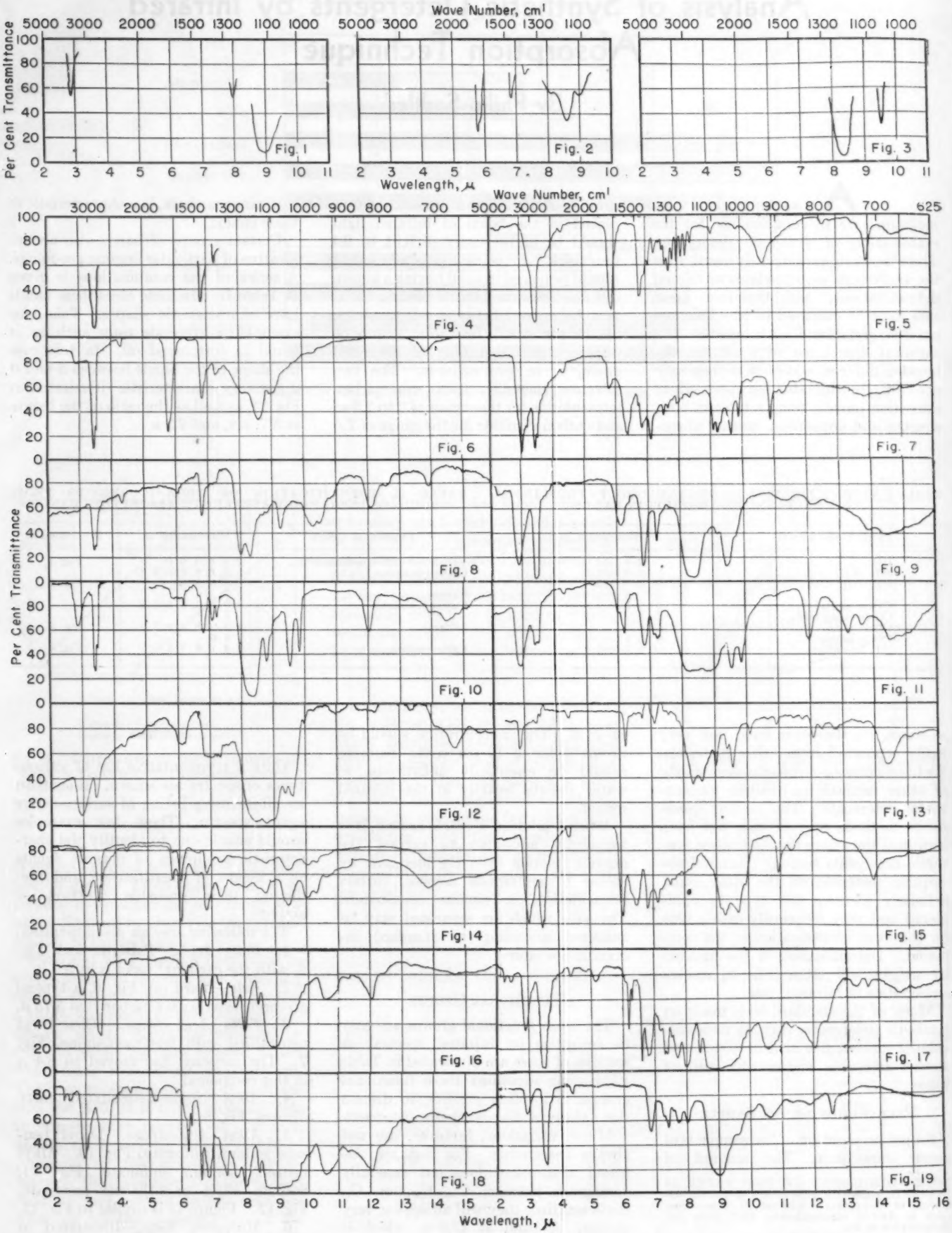
Only a representative list of various types of spectra are shown, rather than an all-inclusive listing of surface-active agent spectra. These few examples should enable one to identify the characteristic groupings of organic agents as a means of identification and predicting their probable function or activity.

The following spectra are illustrated:

1. *Fatty Acids.*—Palmitic acid, Fig. 5, with the carbonyl band is at 5.9 μ.
2. *Fats.*—Lard oil, Fig. 6, a typical glyceride ester with a carbonyl at 5.75 μ.
3. *Fatty Acid Soaps.*—Oleic acid neutralized with triethanolamine, Fig. 7. The carbonyl has moved to 6.4 μ in this compound.
4. *Alkyl Sulfates.*—Sulfated fatty alcohol, Fig. 8.
5. *Alkyl Arylsulfates.*—Decyl benzene sodium sulfonate, Fig. 10. Alkyl benzene sodium sulfonate, Fig. 11. Sodium alkyl naphthalene sulfonate, Fig. 12. Figure 13 is similar to Fig. 12.
6. *Mahogany Soap.*—Illustrated in Fig. 9.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] President, Samuel P. Sadtler and Son, Inc., Philadelphia, Pa.


Wave Number, cm¹
Per Cent Transmittance
Wavelength, μ
Fig. 1
Fig. 2
Fig. 3
Fig. 4
Fig. 5
Fig. 6
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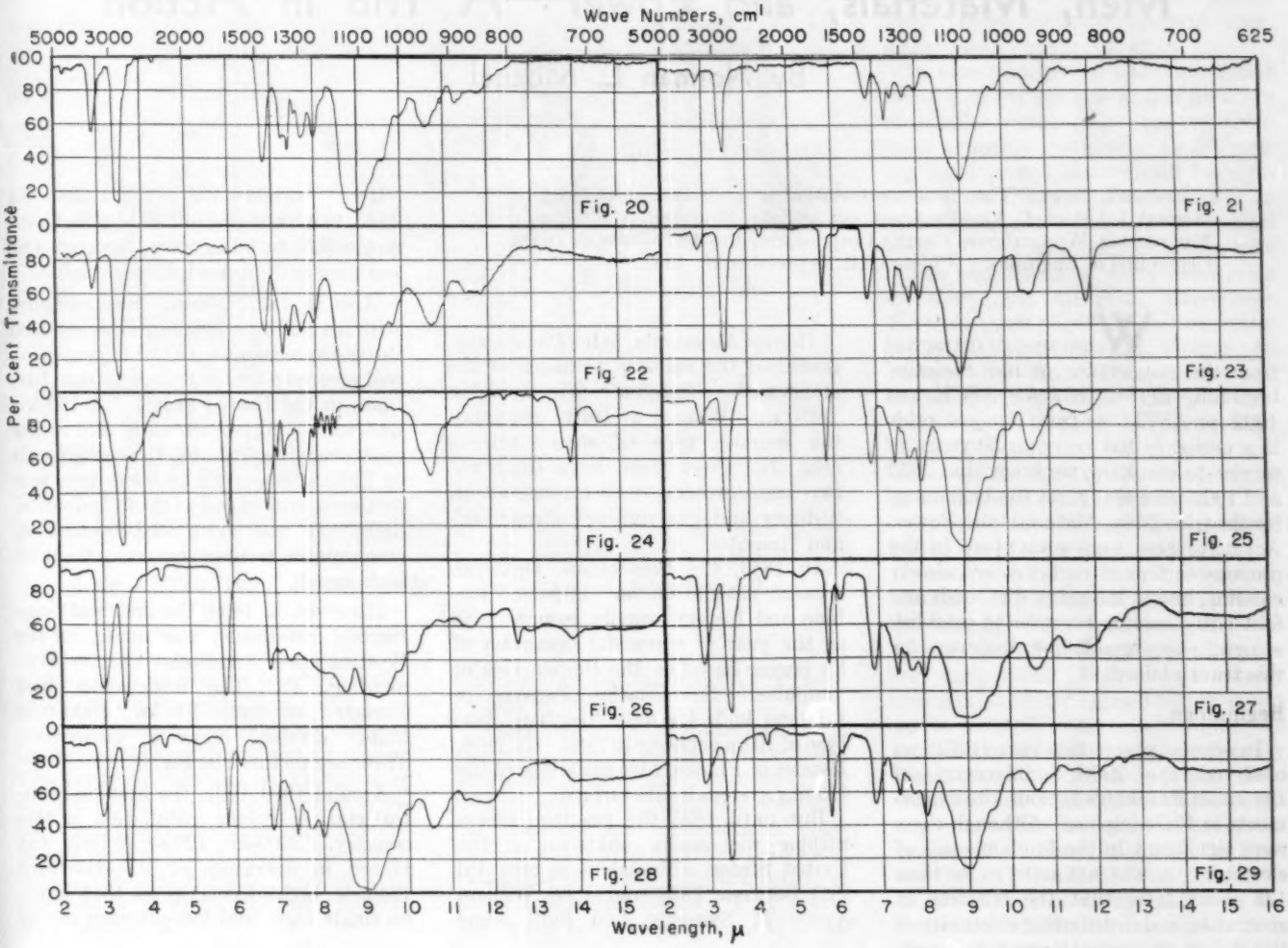

7. *Cationic Detergents.*—A cationic surface agent, known as a substituted oxyaloine, Fig. 14. A cationic agent with a long chain fatty acid, Fig. 15.

8. *Nonionics:*

(*a*) Ethylene oxide substituted phenol condensations, Figs. 16, 17, and 18. These three agents are made by three different companies and are quite similar.

(*b*) Ethylene oxide thiol condensations, Figs. 19 and 20. These two products are very similar, though distinguishing characteristics are to be found at 11.3 and 12.6 μ.

(*c*) Ethylene oxide propylene glycol condensations, Figs. 21 and 22. The differences between Figs. 16, 21, and 22 are essentially that of chain length.

(*d*) Polyoxyethylene fatty acid condensate, Fig. 23, is a polyoxyethylene stearate. In comparing this with Fig. 24, which is stearic acid, note that some of the stearic acid characteristics have carried over, such as a small band at 13.9 and 10.6 μ. The carbonyl has shifted from 5.9 to 5.8 μ, the glyceride ester characteristics are not present at 8.6 μ. This is an ether-type ester.

(*e*) Polyoxyethylene polyglycol fatty acid condensates. A polyethylene ester of mixed fatty and rosin ester, Fig. 25, shows the usual ethylene oxide condensation characteristics. A sorbitan ester, Fig. 26, being a polyhydric alcohol, does have the 8.6 μ band. There are also unreacted OH groups, as shown at 3.0 μ.

(*f*) Polyethylene polyhydric alcohol ester of fatty acids. The characteristic differences of polyoxyethylene sorbitan monolaruate, Fig. 27, and a sorbitan ester, Fig. 26, can be shown by the OH at 2.9 μ, and the ether groups at 8.0 and 8.8 μ, which are found in Fig. 27, but not in Fig. 26. Polyoxyethylene sorbitan mono oleate, Fig. 28, and polyoxyethylene sorbitol ester of fatty and rosin acids, Fig. 29, are similar, except that the 13.9 μ band of Fig. 28 has disappeared in Fig. 29.

Men, Materials, and Power—A Trio in Action

By Norman L. Mochel

EDITOR'S NOTE.—This is a condensation of an address delivered by Normal L. Mochel, Vice-President of ASTM; Manager, Metallurgical Engineering, Westinghouse Electric Corp., during the ASTM session at the Centennial of Engineering, Chicago, Ill., September 10, 1952.

WITHOUT detracting from the importance of our Societies' beginning dates, 1852 for ASCE and 1902 for ASTM, or from our just pride in a period of 100 years, or 50 years, of service to mankind, we know that 1852 and 1902 were really not the beginnings for the trio: Man, Materials and Power. Actually these were somewhere in the dimness or fogs of earlier years, slowly clearing, and in the many dirt roads and foot paths coming together to establish a new, ever broadening highway for this trio to follow.

Beginnings

In several places this year (1952) we observed the 200th anniversary of Benjamin Franklin's famous kite experiments in Philadelphia. Although these were significant in the fundamentals of electricity, it was not until more than 125 years later that the business of generating and distributing electricity—so vital to us now—emerged as a new enterprise.

It we would attempt to evaluate the influence exerted on the human race by developments along materials lines, leaving out those of a moral or spiritual nature, we would find few indeed that can come even close to matching the importance of those concerning the manufacture, distribution, and use of readily available, relatively cheap, electric power. Among the author's prized possessions is a copy of the 38th Edition, dated 1881, of Haswell's "Engineers' and Mechanics' Pocket-Book"; but no reference to "electricity" appears in the book of 1881. The nearest thing is one paragraph classifying "lightning." There are, however, several pages relative to "hydraulic turbines," and many on "boilers" and "steam engines." There is no mention of "steam turbines."

Pictured in Fig. 1 is a 2000-hp Corliss steam engine exhibited at the Centennial Exposition in Philadelphia in 1876. Shown alongside is a 2500-hp marine steam turbine and reduction gear of an early vintage. Remember the massive size and the apparent amount of metal in these giants, when weight reductions are discussed later.

Hero of Alexandria, in his *Pneumatica*, described the reaction principle of the steam turbine in 130 B.C. (Fig. 2) and in 1629 A.D., Branca, in Italy, developed the impulse type of steam turbine (Fig. 2). From them have come the two main prototypes of modern steam turbines and gas turbines—"reaction" and "impulse."

In 1883, the Frenchman, DeLaval, secured patents on an "impulse" turbine and history usually records 1888 as the year of successful operation of his engine based on the Branca idea of "impulse." Sir Charles Parsons in England built his first "reaction" turbine of 10 hp capacity in 1884. In 1898, Rateau in France, also made use of the Branca system in his turbine.

But until 1895 the practical steam turbine was really unknown in the United States, although it is recorded that between 1833 and 1836 William Avery of Syracuse had built some "Hero" turbines for sawmill use. In 1895, two Swedish-built 300-hp DeLaval single-disk turbines were imported and installed in New York Edison plants.

Also in 1895, George Westinghouse with his characteristic foresight, entered into an agreement with the Parsons Co., and secured a license to build steam turbines in the United States. A 150-kw unit was imported for study and in the next year, the first American-built unit of 120 kw, operating at 5000 rpm, was produced and installed in an industrial plant. It was short-lived because of commutator trouble stemming from its high speed.

However, in 1899, the first real commercial installation was made, at the Westinghouse Air Brake Co., in Wilmerding, Pa. The installation first consisted of three 400-kw, 3600-rpm units, driving 60-cycle generators. These are pictured in Fig. 3.

Around 1900–1902, the first real central station turbine installation in this country, a 2000-kw, 1200-rpm unit, was placed in operation at the Hartford Electric Light Co. Up to that time, no single high- and low-pressure casing

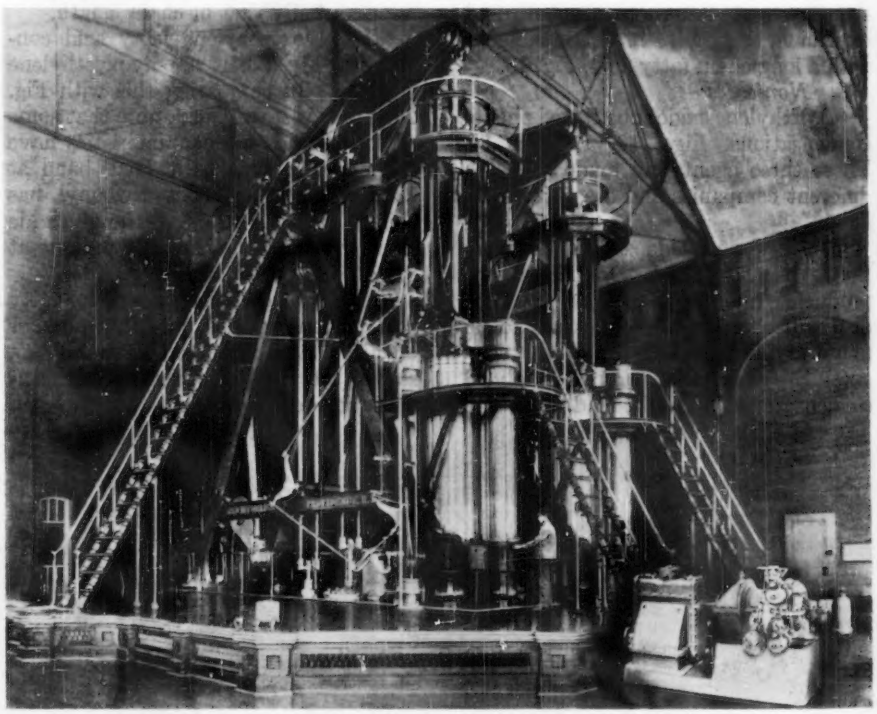

Fig. 1.—2000-hp Corliss Engine Centennial Exposition, Philadelphia, 1876.

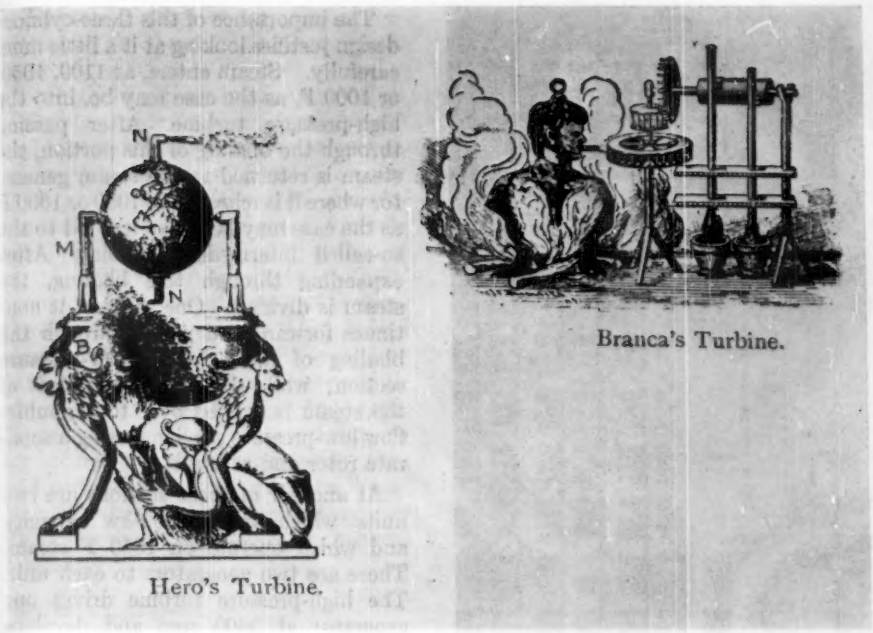

Fig. 2.—The "Hero" Turbine 130 BC. The "Branca" Turbine 1629 AD.

unit larger than 500 kw had been built, and even with separate high- and low-pressure casings, the 1000-kw unit was the largest that had been built anywhere. The Hartford unit was not particularly successful from the standpoint of reliability and the two-cylinder tandem compound design was adopted. In 1903, sixteen, straight-tandem, Parsons-type turbines of 1000 to 1500-kw capacity were constructed.

Thus the years 1902–1903 mark the commencement of the general introduction of the steam turbine into the power plants of the country. Also it would appear that at least the partial success of the Hartford unit led the General Electric Co. to enter the steam turbine field. The Allis-Chalmers Co., too, secured license to manufacture Parsons turbines in 1904.

Even now requests are received to supply blading, of the old 400-kw, Parsons design, that are over 50 years old—an indication of the life and reliability of these early units.

Modern Steam Turbine Plants

In 1935, a unit went into operation at the Richmond Station of the Philadelphia Electric Co. This, in the author's opinion, marks another high point in turbine development. It is the largest single-shaft unit of the 1800-rpm type ever built. It develops 165,000 kw and operates at 835 F inlet steam temperature and 400 psig pressure. Here greater use of alloy steels was made. Incidentally this installation created another record—for 13 long years it gave regular service, without having its high-pressure turbine opened for examination or repairs.

Many newer installations have been made of higher pressure. These excellent stations exist only because of the vast amount of civil, electrical, mechanical, chemical, and metallurgical engineering which went into their design and construction. They are the work of many minds and hands. They represent many hours of planning and building.

Many ASTM Standards have been used in creating these beautiful stations. Many *other* ASTM activities are represented. The work of practically all of the "A" and "B" committees; many of the "C," "D," and "E" committees; and of the joint committees with other societies is used in the building and operation of such modern power plants. Truly, these stations represent men, materials and power, in action.

In a modern power plant are found items of major equipment and numbers of smaller items. Any one of these items probably would offer an interesting development history; all have involved metallurgical development. In such a plant, everywhere, are pipes of all sizes, painted with various colors with valves and fittings of every description on them, and all going somewhere. Here, the parts played by Subcommittee XXII on Valves, Fittings, Pipings and Flanges for High Temperature and Subatmospheric Temperatures and Subcommittee IX on Steel Tubing and Pipe, of ASTM Committee A-1 on Steel might be recognized and their work of over 25 years in these fields appreciated.

In this plant one might be impressed by the size of the boiler, or steam generator as some call it. One of these modern central station steam generators is illustrated in Fig. 4 and is as tall as the 12-story office building placed alongside for comparison. Boilers now supply steam up to 2400 psig, and temperatures up to 1100 F. One can imagine the tremendous amount of steel of every form that this giant requires. Into the field of high-temperature, high-pressure boilers has gone some of the best work of Committee A-1 on Steel and the ASTM-ASME Joint Committee on the Effect of Temperature on the Properties of Metals. A Boiler Code prepared and maintained by the ASME has become the law in most states. Our Society works closely with this Code Committee, the specifications for materials in the Code having been prepared by ASTM.

In a modern, large surface condenser used in present-day central steam

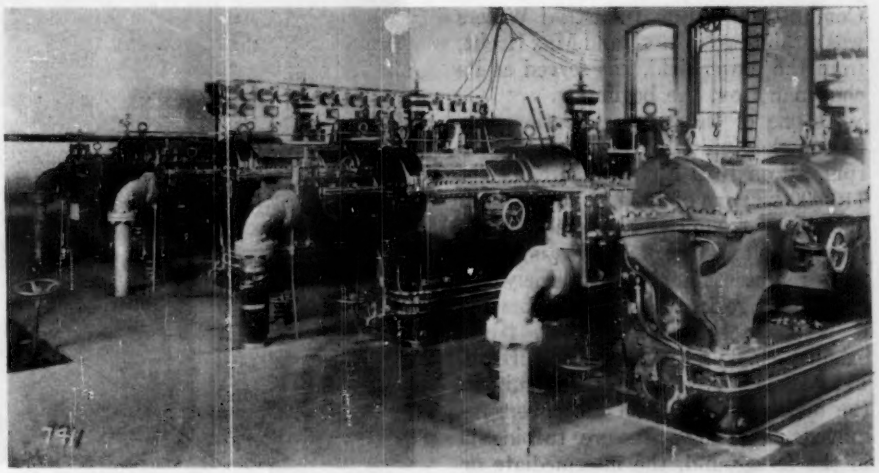

Fig. 3.—400-kw Steam Turbines, 1899. Westinghouse Airbrake Co., Wilmerding, Pa.

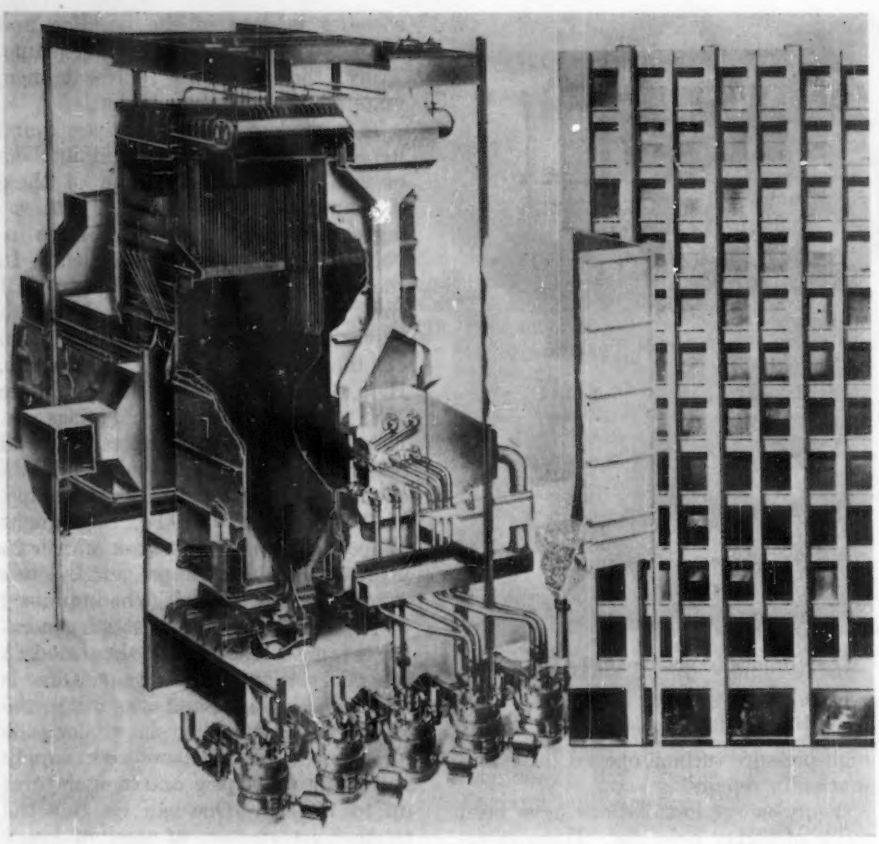

Fig. 4.—Modern Central Station Steam Generator (Courtesy Babcock & Wilcox Co.).

generating stations there are thousands of tubes through which passes the cooling water. Many ASTM members can recall the services rendered by the Society in the early '20's in effecting standards for condenser tubes and tube sheets. These standards have stood the test of time. Also, some are around who will recall studies and debates on grain size, "season cracking," analysis, and manufacture.

Many gallons of water are used for steam generation, cooling, and other purposes in today's power plants. ASTM Committee D-19 on Industrial Waters was established in 1932, and Max Hecht, from the power field, has served as its chairman from the beginning.

At one of these newer stations are four modern units, all operating at 3600 rpm, all on 1050 F steam, three are of 110,000 kw, one of 125,000 kw, two are Westinghouse units, two are General Electric units. One of the Westinghouse units represents another extremely important stage in turbine development; it is a three-cylinder, reheat, triple exhaust, single-shaft, 3600-rpm turbine. Figure 5 is a shop view of this unit, in the maker's plant, with the covers removed. The high-pressure turbine is in the foreground, the intermediate or reheat turbine with one third of the low pressure steam in the middle, and the two-thirds low pressure steam beyond. The forged rotors, the blading, the bolting, the cast steel cylinders, the fabricated low-pressure casing should be noted.

The importance of this three-cylinder design justifies looking at it a little more carefully. Steam enters, at 1100, 1050, or 1000 F, as the case may be, into the high-pressure turbine. After passing through the blading of this portion, the steam is returned to the steam generator where it is reheated to 1050 or 1000 F as the case may be; then it is led to the so-called intermediate turbine. After expanding through this blading, the steam is divided. One third of it continues forward and passes through the blading of a single-flow low-pressure section; while the other two thirds of the steam is carried over to a double-flow low-pressure portion having a separate rotor and casing.

At another of these stations are two units which are 150,000-kw capacity and which operate on 1050 F steam. There are two generators to each unit. The high-pressure turbine drives one generator at 3600 rpm and develops 50,000 kw. The intermediate-pressure and the low-pressure turbines are coupled together and drive a larger generator at 1800 rpm and develop 100,000 kw. A third unit to be installed at this station will be of 165,000-kw capacity and will operate on 1050 F inlet steam also, but with 1000 F reheat before the steam passes to the intermediate pressure cylinder. The low-pressure rotor will be of an all-disk design to avoid the necessity of very large rotor forgings.

The importance of large, single-piece forgings for both generator and turbine rotors is worthy of mention. Without such reliable forgings, present developments hardly could have taken place.

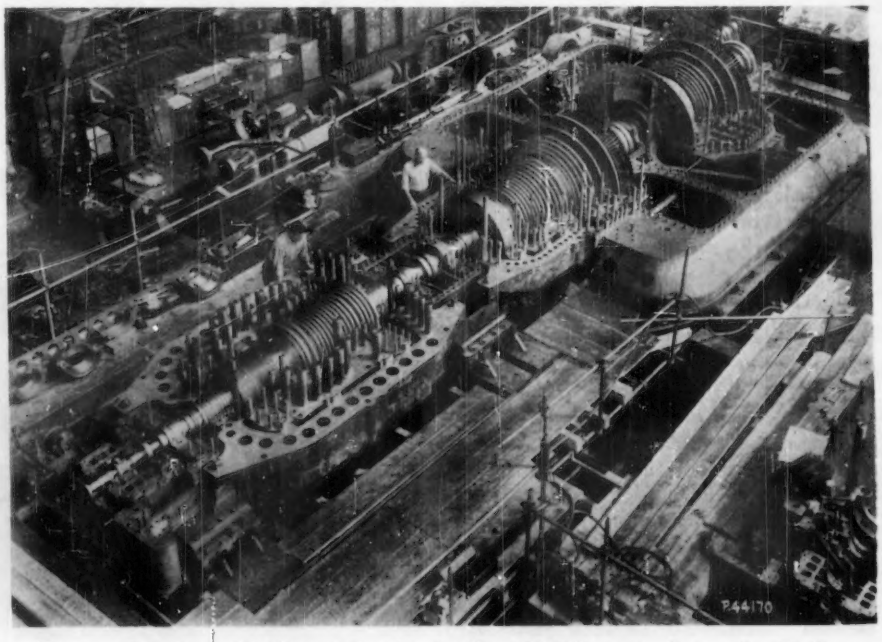

Fig. 5.—Shop Assembly View of Turbine for No. 4 Unit Sewaren Generating Station.

Generator rotors of today, for new important 3600-rpm units have been made with diameters up to 43 in. and a main body length of 200 in. and over.

Turbine rotor forgings, finish machined for blade installation now have been made with diameters up to 55 in. for 3600-rpm units. Ni-Cr-Mo-V and Cr-Mo-V steels are used, and without resorting to liquid quenching, yield strengths up to 100,000 psi are being realized. Strength and stability at metal temperatures sometimes over 1000 F are essential characteristics. Soundness naturally is a requirement, even with supersonic testing being employed. There have been ASTM specifications for turbine and generator rotor forgings and turbine disks since early in World War II, when the National Emergency Steel Specifications activities necessitated such standards.

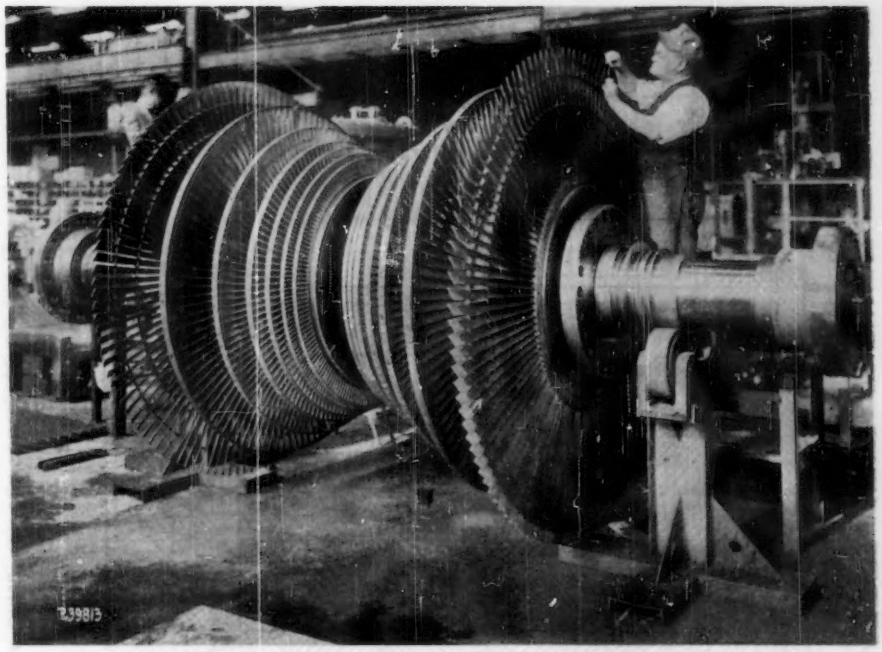

Fig. 6.—Low-Pressure Bladed Turbine Rotor—3600 rpm.

Blades

In the matter of turbine blading, facilities have to be maintained to remake all the types, forms, and sizes of blades that have been made for more than 50 years.

The term blading does not mean just the blades alone. It includes the many related parts that go to make up the steam path. In all, it involves the following (blade forming facilities must include space for forming and storing all of these):

Blades—including rotating blades, stationary blades, nozzle block and diaphragm inserts, and vanes.
Lasting wires—of many types and materials.
Shrouds—of many types and materials.
Packing pieces and caulking pieces—a host of types.
Steel strips (older dummy sections).
Blade bins.

Blading is no longer made just for steam turbines. In recent years jet engines, gas turbines, and compressors and blowers have created even greater and more diversified demands for blading.

In the steam turbine field, through the years, turbines have been built or are being built ranging from little $\frac{3}{4}$-kw units up 200,000-kw units. The manufacturers must be able to maintain all.

Naturally there have been many changes in blading materials through the 50 years, in order to meet the ever-higher temperatures and pressures. Although many materials handled in the past are no longer being made into blading, today one can find in various stages of fabrication such a variety of materials as listed below:

Carbon steel (2 grades)
12 per cent chromium steel (3 modifications)
4 per cent manganese copper
Pure nickel
Aluminum
18–8 stainless steel
25–20 stainless steel
K-42-B
Refractaloy
Inconel-X
Cast stellites
Titanium alloys

Also, through the years there have been a number of improvements in turbine blade sections, in blade fastenings, in nozzle block and diaphragm construction, and in the shape of blades and auxiliary parts in general. There are Curtis or impulse blades, Parsons or reaction blades, Rateau blades, and warped and tapered blades, and compressor blade and vane sections.

The development from comparatively thin blade sections in a brass material to the heavy blunt-edge sections of today in low-carbon 12 per cent chromium steel has been an important matter. The heavy section permits the formation

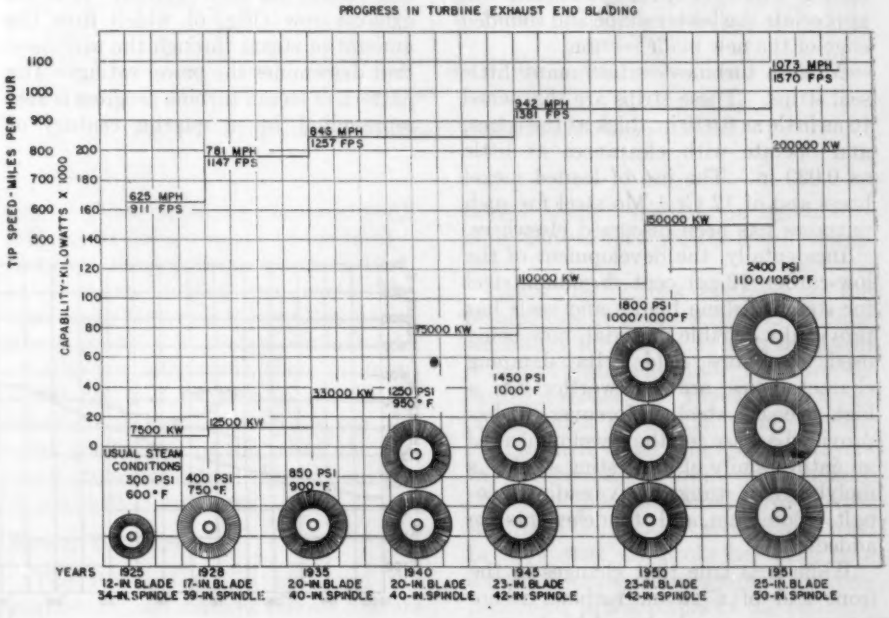

Fig. 7.—Progress in Turbine Exhaust End Blading.

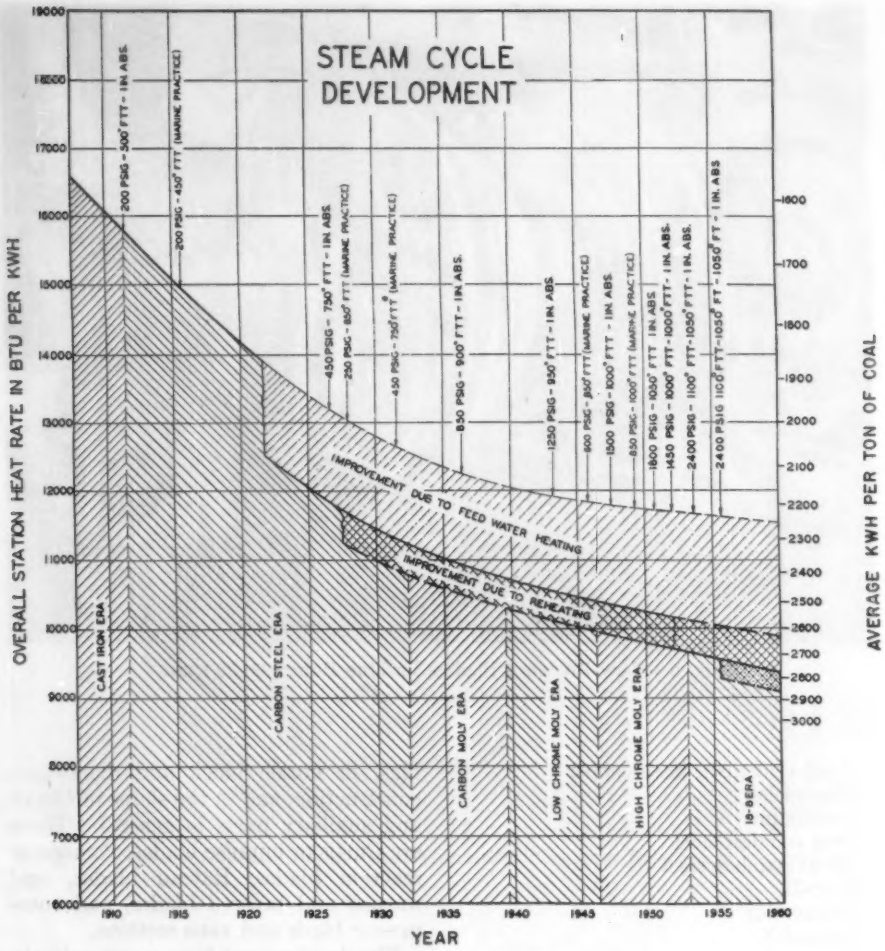

Fig. 8.—Steam Cycle Development.

of a rivet tenon of ample size to secure the shroud band to the outer end of the blade. Students of fatigue failures will appreciate the better shape and rounded edge of the new blade section.

Modern turbines contain many little seal strips. These strips are sharpened to as little as 0.010 in. thick at the edges, and operate with clearances as little as 0.020 in. The use of leaded nickel brass and of 12 Cr ½ Mo steel for such purposes has been discussed elsewhere.

Incidentally, the development of the low-carbon 12 per cent chromium steel for steam turbine blades and seals has provided a reliable material, now being used in many fields. Its damping characteristics are noteworthy for a high-strength steel. Moreover, it has provided a base for the development of an entire family of interesting steels, as molybdenum, tungsten, vanadium, cobalt, columbium, and other elements are added.

While it is true that changes in the front end of a steam turbine, where pressures are now high and blades now glow red, have been associated to a high degree with the evolution of today's turbine, the importance of the exhaust end should not be forgotten. It is the exhaust row (Fig. 6) which fixes the amount of steam through the turbine—that determines the power rating. The pattern of steam turbine progress is also represented by a quarter century of evolution in design of the last-row blades and the exhaust arrangement, which is summarized in Fig. 7. (Also, the triple exhaust feature earlier referred to is shown graphically here.) The 25-in. blade is now an actuality. The tip speed of this blade is 1570 ft per sec. There will be blades longer than 25 in. wanted, for newer 3600-rpm turbines. Whether these will be hollow, or made of titanium, in order to reduce the centrifugal loading, it is too early to predict. Titanium blades have been forged.

The last row of blades for 1800-rpm turbines reached a length of 40 in. Compare this with the 25-in. blade for the 3600-rpm machines and the little blades of about ½ in. in length that would have been found in the 2000-kw Hartford unit of 1902.

Other Developments

Forged throttle-valve bodies and forged and weld-assembled steam chests in many alloy steels including 18–8 Cb, 2¼ Cr 1 Mo, and CrMoV, also are interesting developments of recent years.

Excellent cooperation between the larger steel foundries and the turbine builders has resulted in excellent turbine-casing castings produced in all types of Cr-Mo and Cr-Mo-V steels. ASTM specifications have now been provided for these castings.

Steam inlet piping in the many alloy steels, with many welded connections, has given many problems. One can at times find as many as 54 pipe welds in sizes 6 in. and larger at the front end of a modern turbine. Again ASTM specifications are standard for materials for these purposes.

Recent Trends

And now, let's see how far we have come and where we are.

Note in Fig. 8 how the advancement in materials, the use of feedwater heat-

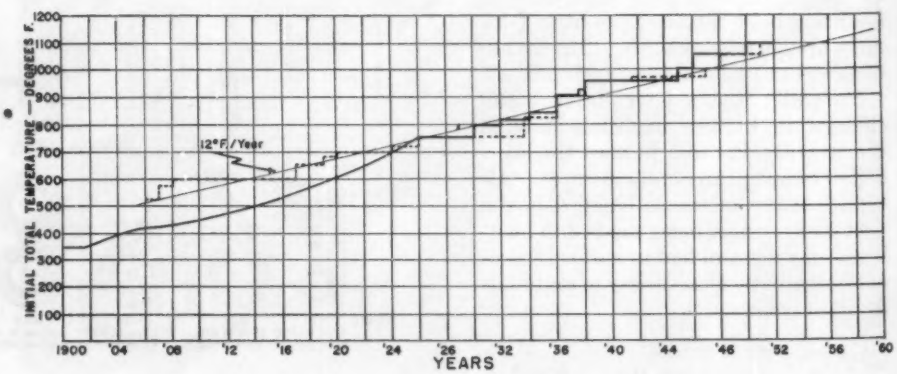

Fig. 9.—Progress in Steam Turbine Inlet Steam Temperature.

ing, employment of reheating, and the use of higher temperatures and pressures, as the years have passed, has consistently improved the over-all station heat rate and the output of the coal pile.

By 1950 the 3600-rpm turbine reached a capacity of 125,000 kw and with a 1050 F inlet steam temperature. But even then, D. W. R. Morgan courageously talked of capacities of 300,000 kw. Already turbines are being built for 185,000 kw at 1100 F and 200,000 kw at 1000 F and orders have been placed for 250,000-kw capacity. These units are of the 3600-rpm, single-shaft, three-cylinder, triple-exhaust, reheat type. Cooling of high-pressure casings is by careful control of steam flow.

In the last 50 or so years, we have made progress that affects materials considerations in several other interesting ways: Turbine steam inlet temperatures have increased at the rate of 12 F per year. Two turbine builders' progress is charted in Fig. 9.

Figure 10 illustrates progress along weight reduction lines. A new unit to go into service in 1954 will require but 18 lb of structural steel per kw of capacity, whereas construction in 1945 units required 40 lb per kw. There has been a great reduction in floor space during the past 50 yr as shown in Fig. 11.

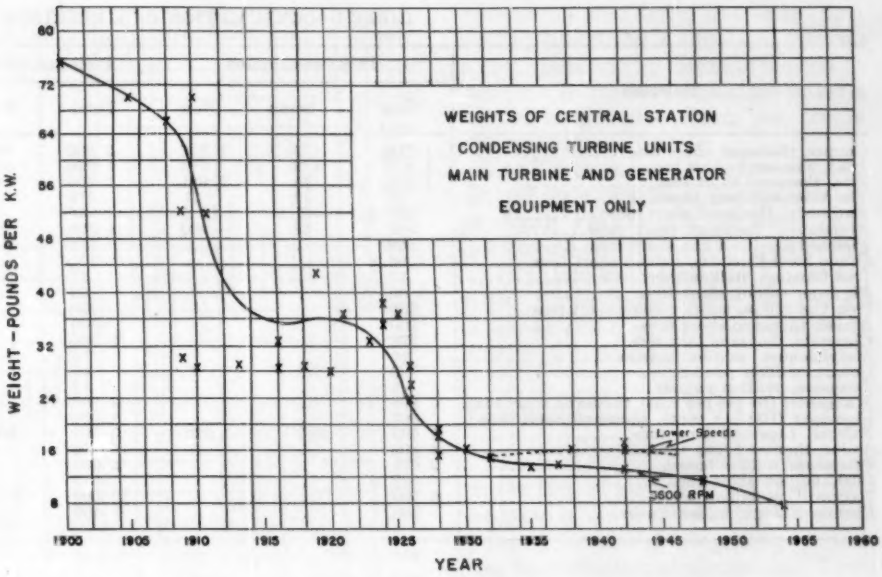

Fig. 10.—Progress in Weight Reduction of Steam Turbine.

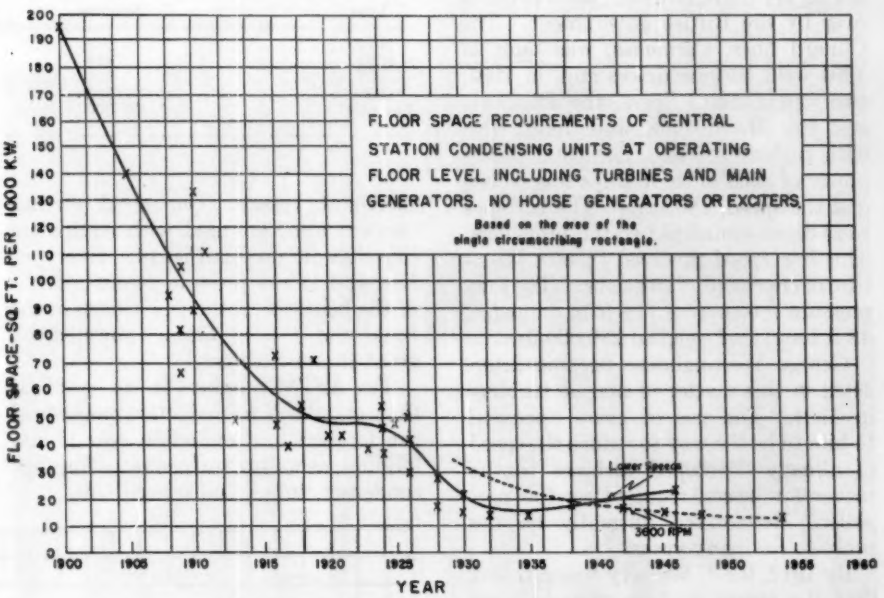
FLOOR SPACE REQUIREMENTS OF CENTRAL
STATION CONDENSING UNITS AT OPERATING
FLOOR LEVEL INCLUDING TURBINES AND MAIN
GENERATORS. NO HOUSE GENERATORS OR EXCITERS.
Based on the area of the
single circumscribing rectangle.
FLOOR SPACE–SQ. FT. PER 1000 K.W.
YEAR
Lower Speeds
3600 RPM

Fig. 11.—Progress in Floor Space Reduction of Steam Turbine.

Some Forecasts

And now what is ahead? Ayres and Scarlott have shown the domestic consumption of electricity over the years (Table I). They suggest a tremendous increase in the amount that our children will use. It has been estimated that our 156,000,000 population of 1952 will be 175,000,000 by 1961. Our needs are growing. Our defense production is growing. Atomic energy development needs a lot of power. The author has prepared a chart (Fig. 12) in which have been combined a number of published and unpublished estimates as to where the experts feel we are going, in the matter of generating capacity. A second chart (Table II) combines published and unpublished estimates as to probable output.

And of course such estimates can only be made by courageous people who believe in our country, and its future greatness.

"Energy Sources—The Wealth of the World" by Ayres and Scarlott, which reached the bookshelves earlier this year, merits careful study.

The Census of Manufacturers data (Fig. 13) released recently by the Department of Commerce reveals many interesting facts. In 1950, the primary metals industries were the largest users of electric power—20.5 per cent of the total. These industries consumed 251.9 millions of dollars worth of electricity, and over 188.8 millions worth in 1947, an increase of 33.5 per cent. The President's Materials Policy Commission report provides important estimates to all who are interested; these estimate a 260 per cent increase in the use of electrical energy by 1975. From the other predictions in the table, the primary metal industries should continue to use their large share.

Newer Turbines

The story of the turbine and the engineering and materials developments incident thereto would not be complete unless three additional items are mentioned briefly: the marine steam turbine; the gas turbine; the use of atomic power.

Sir Charles Parsons very early saw the possibilities of steam turbine propelling machinery for ships. During the naval review at Spithead in 1897, the *Turbinia* caused a sensation. It reached a speed of $32\frac{3}{4}$ knots, never realized before with such a small vessel. Several destroyers were immediately built in England. But one of them foundered. Newspaper reports of the accident erroneously tried to show that she broke her back in a seaway because of the gyroscopic forces incidental to the rotors of the turbines. This failure caused a serious setback in marine turbine development.

TABLE I—CONSUMPTION OF MATERIALS.

Materials	1950 Consumption			Projected 1975 Consumption			Percentage Increase	
	Total	Scrap	New	Total	Scrap	New	Total Demand	New Material Demand
Copper, thousand short tons	1 730	475	1 255	2 500	700	1 800	45	43
Lead, thousand short tons	1 212	428	784	1 950	750	1 200	61	53
Zinc, thousand short tons	1 156	75	1 081	1 600	100	1 500	38	39
Tin, thousand long tons	93	22	71	118	34	84	27	18
Antimony, thousand short tons	37.4	21.9	15.5	66	38	28	76	81
Aluminum, thousand short tons	983	63	920	4 500	900	3 600	358	291
Finished Steel, million short tons	68	...	...	110	...	...	62	...
Crude Steel Products, million short tons	96.8	...	...	150	...	...	55	...
Iron Castings, million short tons	13.5	...	...	22	...	...	62	...
Pig Iron, million short tons	65	...	...	100	...	...	54	...
Iron Ore (50 per cent), million short tons	130	...	...	200	...	...	54	...
Nickel, thousand short tons	100	...	...	200	...	...	100	...
Chromite, thousand long tons	875	...	...	1 750	...	...	100	...
Molybdenum, million pounds	26	...	...	70	...	...	170	...
Cobalt, million pounds	9	...	...	40	...	...	340	...
Tungsten, million pounds	6	...	...	15	...	...	150	...
Manganese Ore (46 per cent), thousand short tons	1 800	...	...	2 700	...	...	50	...
Fluorspar (100 per cent), thousand short tons	369	...	...	1 060	...	...	187	...
Rubber, thousand long tons	1 620	300	1 320	3 300	800	2 500	104	89
Sulfur, thousand long tons	4 806	...	...	10 100	...	...	110	...
Petroleum, million barrels	2 375	...	...	5 000	...	...	110	...
Coal, million short tons	522	...	...	815	...	...	56	...
Natural Gas, billion cu ft	6 300	...	...	15 000	...	...	138	...
Electric Energy, billion kw-hr	389	...	...	1 400	...	...	260	...

But in 1902 the building of a new destroyer was privately financed. Following her trials, however, she was taken over by the British government. The Cunard liner, *Carmania*, was built in 1904 with turbine drives and, in 1907, two new Cunard liners, the *Lusitania* and the *Mauretania*, were built, also with turbine drives. The total horsepower of each of these ships was 68,000 and the speed, 180 rpm. The turbines were direct-connected to the propellers. This low speed involved turbine structure of enormous dimensions. The low-pressure rotors were 11¾ ft in diameter, 48 ft long, and weighed 280,000 lb.

George Westinghouse became interested in this matter of marine turbines in 1904. The use of gears appeared to him to be the way to reduce the speed of already developed turbines to the rather low speed required by the propeller. He worked diligently on the problem for many years.

By 1912, the U.S. Navy was satisfied that the geared turbine must be considered seriously as a drive for ships. At the same time, it was anxious to investigate the possibilities of a new drive—electric propulsion—which also had been developed. In order to obtain first-hand information on these new drives, the Navy planned an experiment on a monumental scale and built three colliers, all exactly alike except that one, the *Neptune*, was propelled by geared turbines, the second, the *Jupiter*, was electrically propelled, and the third, the ill-fated *Cyclops*, had reciprocating engines.

All of these three ships had been commissioned by the end of 1915. They were carefully studied under actual service conditions.

In the 40 years since the *Neptune*'s time, the turbine geared drive has become "the marine drive" for naval and merchant vessels. Our great aircraft carriers were powered with equipment like that pictured in Fig. 14. Everyone has read in the press in recent months of the behavior of the new Queen of the Seas—the *United States*—powered by great steam turbines.

TABLE II.—UNITED STATES DOMESTIC CONSUMPTION OF ELECTRICITY.
(In kilowatt-hours per annum per householder.)

Year	Amount
1917	268
1927	446
1937	800
1950	1 825
Potential	10 000

The ASTM numbers in its specifications standards for reduction gear wheel rim forgings and reduction gear pinion forgings, as well as turbine rotor forgings condenser, tubes, and other items.

Concerning gas turbines, it has been suggested that the development in this field for the next five years will be divided as follows:

Petroleum and gas industry...45 per cent
Central station industry.....35 per cent
Locomotives..... 5 per cent
Other industrial applications..15 per cent

Units up to 15,000 kw for central station application are being built.

L. R. Hafstad, Director, Division of Reactor Development, U. S. Atomic Energy Commission, has stated that one of the two basic reasons why we should build atomic reactors is power—central station power for the country's electric distribution system.

Anyone who reads knows that the keel of the first atomic submarine was laid on June 14, 1952, at Groton, Conn., and that President Truman made the following statement that day:

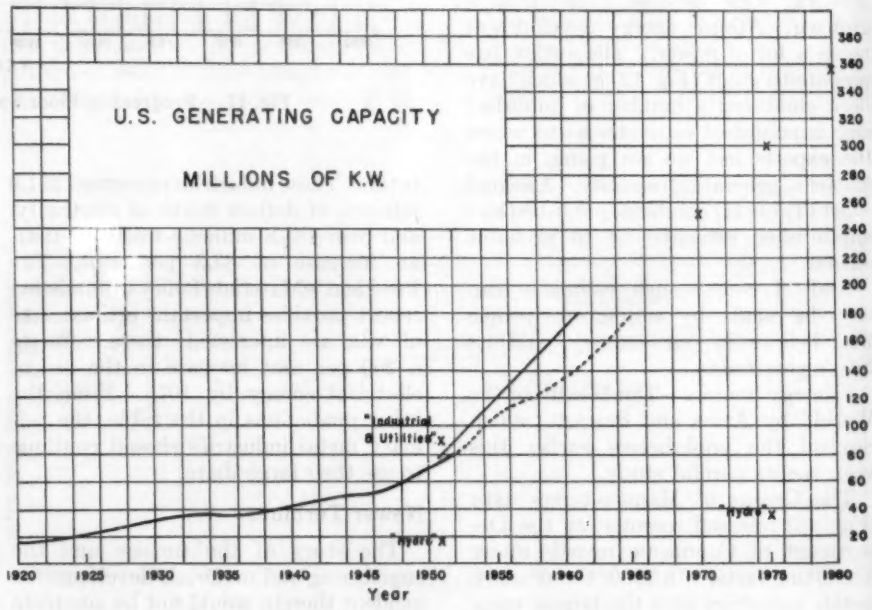

Fig. 12.—U. S. Generating Capacity—Millions of kw.

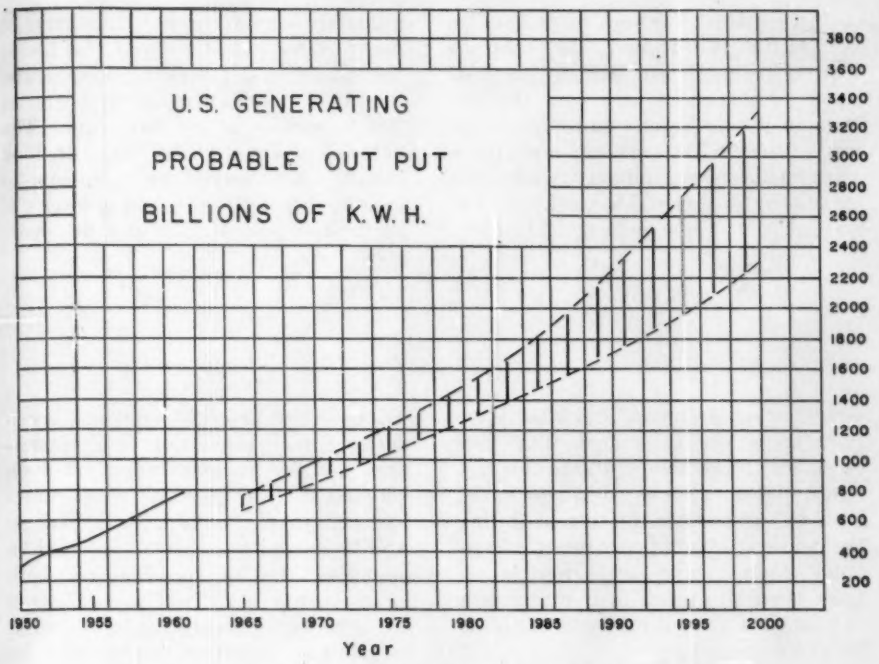

Fig. 13.—U. S. Generating Probable Output—Billions of kw-hr.

source—the heat being transferred to a cooling fluid which is circulated through a heat exchanger by means of blowers or pumps. In the heat exchanger water is heated to generate steam for use in driving a steam turbine.

The Westinghouse Co. has now broken ground for a new $6 million laboratory at South Philadelphia for steam and gas turbine development. Components up to 15,000-kw capacity may be tested here. Steam capacities up to 150,000 lb per hr and temperatures from 800 to 1100 F, will be available.

Conclusion

It would appear that the metal needs in the field of manufactured power will be great in the years ahead. There will be need for new development, for testing, for evaluation of our metals. There will be need for new ASTM standards and methods. And should the gas turbine or the atomic power developments threaten the position of the steam turbine as a power source, the materials

"This vessel is the forerunner of atomic-powered merchant ships and airplanes, and of atomic-powered plants producing electricity for factories, farms and homes. If we could devote a full share of our energies to peaceful development of the atom it should soon be possible to bring this new source of power into daily use. Self-contained power plants, able to run almost indefinitely without refueling, and capable of being moved from place to place, would be within reach."

Those who read *Esquire* know that the May, 1952, issue said much of such a submarine. Also, the public press, and *Life* magazine of August 11, 1952, announced to all that the Navy had started work on an atomic-powered aircraft carrier, and that a study project had been arranged with Westinghouse.

Many will have heard or seen the statement that "there is the same amount of power in 1 lb of fissionable material as in 2,600,000 lb of coal." Truly, the implications of such a statement for the production of central station power are spectacular.

There have been many announcements in the press, the technical press, house papers, etc., that studies are in progress relative to central station power production. The thinking so far is that for the present there is no possibility of constructing a reactor to produce only power—that the manufacture of plutonium as a co-product and its sale to the Government is also necessary.

In the meantime, great progress is being made.

The basic cycle of operation of a nuclear reactor uses the reactor as a heat

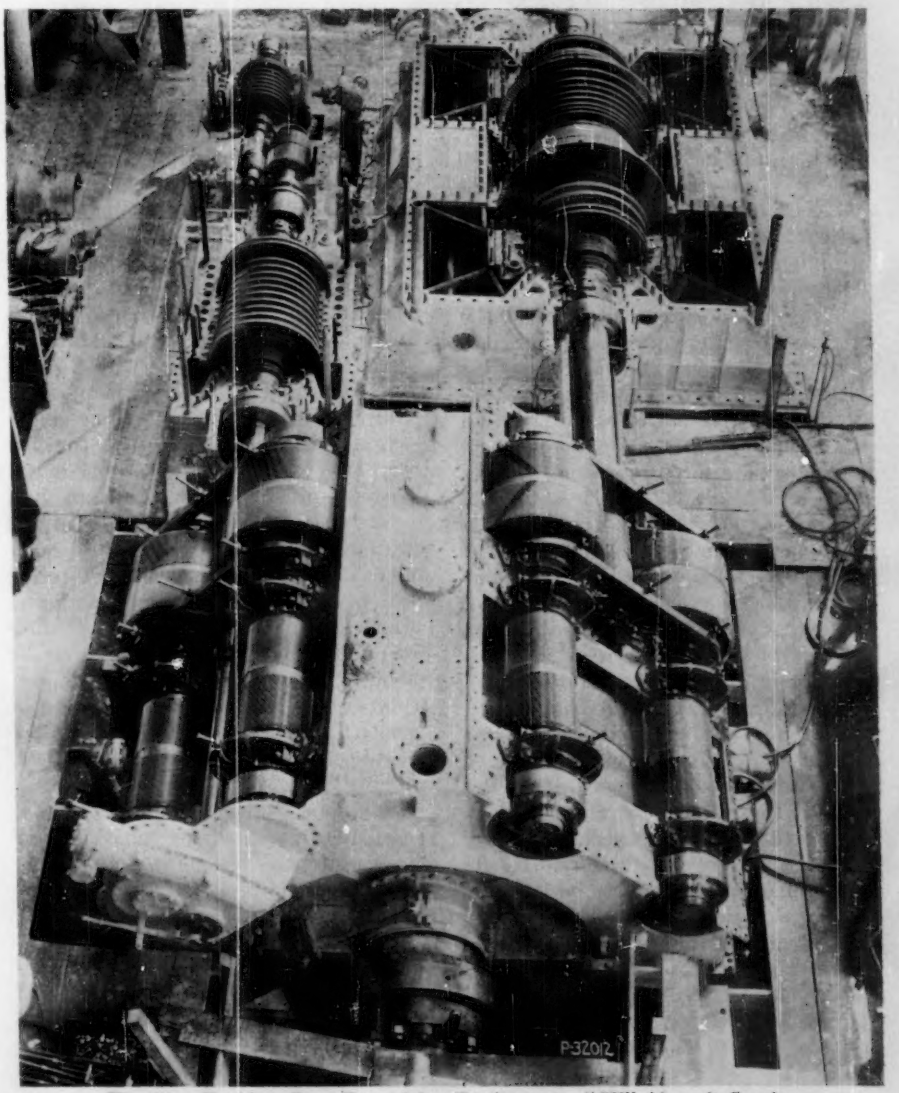

Fig. 14.—Turbine-Gear Propulsion Equipment—"CV" Aircraft Carrier

problems are apt to increase from a metallurgical standpoint.

There will be many questions of supply, especially if our defense needs continue and increase in their demands. A proper balance must be maintained in our applications of our available metals. This applications field must not suffer, since all else depends upon it.

Just a little of the work carried out by ASTM that is of value to the power industry has been pointed out, and so much of this dealt only with the one item in it—its heart. Much could be said of the ASTM work in many others parts of the power industry, within the generating station and beyond. This is service to but one industry. Equally valuable service has been rendered to many other industries and the home, the school, and the government. The Society can rejoice in its 50 years, as ASCE rejoices in its 100 years. The older members of the Society can look ahead, with the younger members, to greater responsibilities and greater opportunities for service in the years ahead.

NBS Study Reveals Prior Strain Affects Tensile Properties of Copper

The National Bureau of Standards has recently completed a study of the effect of prior strain history on the room-temperature tensile properties and microstructure of high-purity copper. Tension tests were made on oxygen-free high-conductivity (OFHC) copper initially as annealed, as cold-drawn different amounts, and as prestrained in creep at 110, 250, and 300 F. Results of the investigation conducted by William D. Jenkins and Thomas G. Digges show that the strength, ductility, and hardness of the copper are markedly affected by its prior strain history.

Four bars of OFHC copper, 99.99 plus per cent pure, were procured for the NBS study, all processed from the same lot of copper, but each subjected to different conditions of annealing or cold drawing. Specimens taken from the various bars were subjected at the Bureau to different amounts of prestraining in creep under tension at 110, 250, or 300 F. The differently preconditioned specimens were then all tested in tension at room temperature at the same rate of extension of 1 per cent per min.

Cold-drawing the copper at a relatively fast strain rate generally resulted in increased strength and hardness, but in decreased ductility (as measured by the extension and reduction of area at fracture). Prestraining at a high temperature or at a low strain rate, on the other hand, generally resulted in reduced strength and hardness as well as reduced ductility. Specimens with the larger grain sizes showed lower yield strengths and hardness values; but grain size had very little effect on tensile strength, fracture strength, and ductility. Hardness values of the fractured tension specimens, obtained at room temperature, confirmed the results of the tension tests.

The microstructures of the tension specimens were, in general, consistent with previous assumptions that cracks of a transcrystalline nature, and substructures, are nucleated during the second stage of creep, and that these phenomena are associated with prestraining at low temperatures and fast strain rates. Cracks thus nucleated grew to microscopic dimensions during the tension tests. Prestraining at elevated temperatures and slow strain rates tended to result in fractures of a less ductile type and in cracks of an intercrystalline nature.

Heat Generation in Hardening of Magnesite Cements

A RECENT study by the National Bureau of Standards provides the first published figures on the amount of heat generated in the setting of magnesium oxychloride cements. These cements generate much more heat in the process of hardening than does portland cement, and this might cause serious difficulty under some circumstances.

In this investigation, conducted by ASTM member E. S. Newman, J. V. Gilfrich, and L. S. Wells, nine representative commercial magnesite cements were studied as well as laboratory-mixed pastes consisting only of magnesium oxide, magnesium chloride, and water, in various proportions. For the commercial cements, heat generated during the first 18 hr of hardening (during which time heat generation is substantially complete) was found to be about 190 calories per gram of magnesium oxide. For the laboratory pastes of various proportions, a wide range of heat-of-hardening values was obtained, from 135 to 320 calories per gram of magnesium oxide. The low heats of hardening measured for some of these pastes support the conclusion of previous investigators that free MgO may remain in such pastes.

Electrically conducting magnesite cements are particularly valuable for making nonsparking floors in plants and hospitals. Although it seems well established that they can give excellent service in some applications, some users have reported disappointing results. No generally accepted standard specifications for preparation and application of these cements have yet been adopted. Their increased importance has led to the establishment of an ASTM committee that is engaged in preparing ASTM specifications both for the composition and application of the cements. Cooperating in this work, the Bureau undertook the present investigation of heats of hardening.

Calendar of Other Society Events

"Long" and "short" calendars will appear in alternate BULLETINS. The "short" calendar notes meetings in the few immediate weeks ahead—the "long" calendar for months ahead.

IAS, AIEE, IRE, AND ISA—May 20–22, Joint National Telemetering Conference, Edgewater Beach Hotel, Chicago, Ill.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—May 25–29, Annual Conference and Exhibit, Hotel Schroeder, Milwaukee, Wis.

AMERICAN CHEMICAL SOCIETY—May 27–29, Division of Rubber Chemistry, Boston, Mass.

AMERICAN SOCIETY FOR QUALITY CONTROL—May 27–29, Annual Convention, Convention Hall, Philadelphia, Pa.

INDUSTRIAL RESEARCH CONFERENCE—June 1–5, Harriman Campus, Columbia University, New York City.

SOCIETY OF AUTOMOTIVE ENGINEERS—June 7–12, Summer Meeting, Ambassador & Ritz-Carlton Hotels, Atlantic City, N. Y.

FOREST PRODUCTS RESEARCH SOCIETY—June 15–17, Annual Meeting, Memphis, Tenn.

AMERICAN ELECTROPLATERS' SOCIETY—June 15–18, 40th Annual Convention, Benjamin Franklin Hotel, Philadelphia, Pa.

AMERICAN CHEMICAL SOCIETY—June 15–18, 13th National Organic Chemistry Symposium, Ann Arbor, Mich.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—June 15–19, Summer Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

AMERICAN WELDING SOCIETY—June 16–17, Spring Meeting, Shamrock Hotel, Houston, Tex.

ASSOCIATION OF AMERICAN RAILROADS—June 22–26 Annual Meeting of the Mechanical Division, Atlantic City, N. J.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—June 28–July 2, Semi-annual meeting, Hotel Statler, Los Angeles, Calif.

INSTITUTE OF THE AERONAUTICAL SCIENCES—July 15–16, Annual Summer Meeting and Honors Dinner, IAS Bldg., Los Angeles, Calif.

ASTM Invites Participation in Wood Pole Research

Program Should Result in Large Savings to Producers, Treaters, and Users

INVITATIONS to participate in underwriting an extensive research program on the testing of full-size poles used for a variety of purposes, are being extended by Committee D-7 on wood to producers, treaters, and users of wood poles. It is estimated that the program will result in savings of $1,000,000 annually.

A comprehensive brochure and other descriptive material have been prepared and are being distributed to those vitally concerned with the project.

The research program is of broad character to insure accurate and reliable data. It includes hundreds of tests of full-size poles and thousands of tests of small clear specimens made under standard ASTM procedures.

The schedule of tests is summarized in this tabulation:

Series	Number of Tests						Estimated Cost of Project
	Full-Size Poles	Small Clear Specimens					
		Bending	Compression	Hardness	Toughness	Other	
I	120	600	600	600	600	0	$ 30000
II	180	900	900	900	900	100	45000
III	200	2000	2000	2000	2000	0	75000
Total	500	3500	3500	3500	3500	100	$150000

It is being undertaken to resolve many controversial issues relating to wood poles along the following lines:

1. Data on the strength of full-size poles to provide an accurate design basis for the principal pole species of wood will be procured.
2. Answers to the questions of how knots, spiral grain, checks, and splits affect the strength of poles will be sought, as a basis for improved specifications.
3. It will be determined whether tests of small clear specimens can be used in place of tests of full-size poles to obtain design values.
4. Also, the effect of accepted preservative treating processes on the strength of full-size poles will be determined.
5. A comparison of the reliability and results of the two methods now used for testing full-size poles also will be afforded because of the program.

There is reason to believe that permissible fiber stress values for Southern Pine, Douglas Fir, and Western Red Cedar poles, the three most important pole species, could be increased 10 to 15 per cent. The higher values would permit using smaller poles for a given wire, wind, and ice loading.

Assuming an average saving of only 15 cents per pole, the benefits to the industries on 6,400,000 poles used each year would be about $1,000,000 annually, many times over the cost of the Program.

It is expected that the expense of the Program, estimated at $150,000 (see table) over a two-year period, will be underwritten by the cooperation of pole-producing, pole-treating, and pole-using industries.

While the program as outlined covers the major areas in pole design that need study, there are a number of related problems of interest to special groups. Arrangements may be made for integrating studies of such problems with the general program if the nature of the work is appropriate, and the extra cost is assumed by the specially interested groups.

The research will be under the guidance of a special ASTM Task Group and the testing and analysis of data will be done at the U. S. Forest Products Laboratory, Madison, Wis.

For those who desire to contribute in support of the project checks can be mailed to the Treasurer, American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Checks should be drawn to the order of "ASTM Wood Pole Research Program." Additional information on the project will be sent gladly on request.

Technological Information Service Established by Battelle

A NEW technological information service has been established at Battelle Institute, Columbus, Ohio, aimed at assisting science and industry in streamlining the costly and burdensome job of tapping existing published knowledge.

Finding out "what has gone before" is the obvious question a good research man must answer when he undertakes a study, Battelle Director Clyde Williams points out. With an estimated 60 million pages of technical matter being published each year, this has become a herculean task. "Our aim is to couple appropriate use of improved manual and machine documentation techniques with our long experience in the gathering and organization of research data."

The new service to technology will be tailored to individual needs. It will include the preparation of bibliographies, and coding and classification systems. Where required, the Institute will undertake development of information processing equipment.

"Our decision to establish a technological information service is a natural outgrowth of the experience we've had in tackling specific literature searching problems not only for ourselves, but also for industry and government," Williams explains. "For several years now we have prepared for the American Society for Metals its monthly review of metals literature. Just off the press is an extensive bibliography on titanium technology compiled for the Watertown Arsenal of the U. S. Army Ordnance Corps. We are developing, currently, for the Wright Air Development Center, a machine system for accepting, storing, and searching engineering data on electronic components.

"Present interest on the part of industry and government indicates a healthy growth for the new service. All the latest developments for the scientific processing of information will be brought to bear on the work, including standard business machine punch-card equipment, xeroradiography, microfilming, and pertinent electronic devices. A continuing study will be made on ways and means to improve existing information-processing techniques.

"The end result we are striving for is a technical information center that will save time and money for scientists and research organizations through the elimination of much needless duplication of research effort. The opportunities for so doing are tremendous. Some estimates put the current annual cost of literature searching at 300 to 750 million dollars, or from 10 to 25 per cent of the total 3 billion dollars spent by the nation on research last year."

Battelle staff members assigned to the new service included Dr. Robert C. McMaster, supervisor of electrical engineering research, Dr. Iver Igelsrud, technical librarian, Roger L. Merrill, and Alvin T. Maierson.

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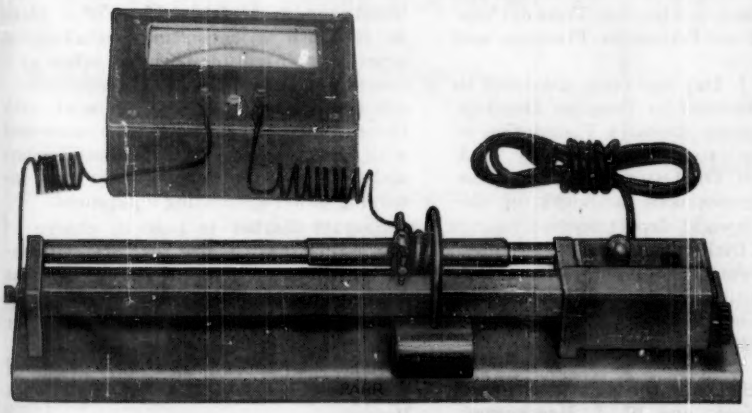

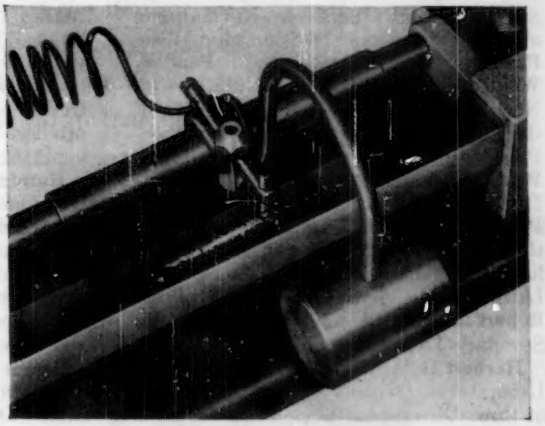

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PERSONALS...

News items concerning the activities of our members will be welcomed for inclusion in this column.

NOTE—*These "Personals" are arranged in order of alphabetical sequence of the names. Frequently two or more members may be referred to in the same note, in which case the first one named is used as a key letter. It is believed that this arrangement will facilitate reference to the news about members.*

At the recent meeting of the Industrial Research Institute, Inc., New York City, **Allen Abrams,** Vice-President in Charge of Research and Development, Marathon Corp., Rothschild, Wis., was elected President of the Institute. **Howard G. Vesper,** President, California Research Corp., San Francisco, Calif., was elected Institute Vice-President and President Elect. **Emil Ott,** Director of Research, Hercules Powder Co., Inc., Wilmington, Del., and **Thomas H. Vaughan,** Vice-President in Charge of Research and Development, Wyandotte Chemicals Corp., Wyandotte, Mich., were among new members of the Institute Board of Directors, elected for three-year terms.

At the Ninth Annual Meeting of the Metal Powder Assn. in Cleveland in April, several active ASTM'ers were among those elected to office. **Thomas L. Robinson,** President, Powdercraft Corp., Spartanburg, S. C., was elected Chairman of the Fabricators Division and Vice-President of the Associatiod. **Paul E. Weingart,** of the American Metal Co., New York City, was elected Chairman of the Powder Producers Division and Vice-President of the Association. **B. T. du Pont,** General Manager, Plastic Metals Div., National Radiator Co., Johnstown, Pa., was elected a Director for the next three years. **George Roberts,** Chief Metallurgist, Vanadium-Alloys Steel Co., Latrobe, Pa., continues as a Director. **Robert L. Ziefeld** was reelected Acting Secretary-Treasurer.

Herbert G. Arlt, of the Bell Telephone Laboratories, Murray Hill, N. J., is one of three Directors-at-large of the recently organized Standards Engineers Society, which group is completing approval of a Constitution and By-laws, and planning for organization of regional sections, with New York as one of the sections being considered.

Wilmer J. Balster resigned as Vice-President and General Manager of the Don L. Quinn Co. and has established a consulting service in all phases of testing, shipping containers, and transportation—known as The Wilmer J. Balster Associates, and operating initially from his home in Chicago, Ill.

Alfred S. Best, formerly Technologist, National Bureau of Standards, is now Project Manager, Office of Industry and Commerce, U. S. Department of Commerce, Washington, D. C.

Victor W. Bihlman has retired as Research Metallurgist, Wheeling Steel Corp., Wheeling, W. Va. Mr. Bihlman, who had represented his company in ASTM and on Committee A-1 on Steel for many years, has been in ill health. W. F. Copp, Director, Department of Metallurgy and Development, succeeds Mr. Bihlman as representative of Wheeling Steel in the Society.

Don S. Bolley has been appointed Technical Director, Baker Castor Oil Co., Bayonne, N. J. He was formerly Director of Research.

Stanley A. Brosky, until recently in charge of the Department of Radiography, Pittsburgh Testing Lab., Pittsburgh, Pa., has established the Brosky X-Ray and Research Laboratories, in Carnegie, Pa.

Edmond H. Bucy, formerly with the Compo Chemical Co., Inc., Boston, Mass., is now Sales Manager, Benjamin Franklin Paint and Varnish Co., Philadelphia, Pa.

G. P. Contractor, who officiated as Acting Director of the National Metallurgical Laboratory of India for several years, is relinquishing his services with the Indian Council of Scientific and Industrial Research, and after four months of privilege leave, will leave India in August for U. K. on his way to Canada.

Harold J. Dawe, Director of Product Development for the Acheson Colloids Co., Division of Acheson Industries, Inc., Port Huron, Mich., has been appointed Technical Director. He will be responsible for all research and development activities of the company. Dr. Dawe represents his company in ASTM, and for some time has been serving as Secretary of the Research Division on Graphite Tests of Committee D-2 on Petroleum Products and Lubricants.

Maurice J. Day has been promoted to Assistant Director for Program Development at Armour Research Foundation of Illinois Institute of Technology. A metals expert, Dr. Day will coordinate the program development activities of the Foundation's eight departments.

Julian D. Dickerson has been appointed Chief Metallurgist for the Midland, Pa., Works, Crucible Steel Co. of America, replacing George Bryer who has been named Service Engineer for the Detroit area.

J. B. Dickson, United States Rubber Co., New York, and **W. J. Hamburger,** Fabric Research Laboratories, Inc., Boston, Mass., are among several prominent American scientists scheduled to present papers at the 38th Annual Conference of the British Textile Inst., to be held May 25–29 at Llandudno, a noted Welsh coastal resort. The conference is to discuss "the structural design and testing of textile materials for specific purposes." British scientists from the laboratories of **Courtaulds, Ltd.,** and other prominent companies and research associations are to give papers, and the British Commonwealth Joint Services Committee has prepared a report on "Tensile Strength Testing of Fabric" setting out the results of an international exchange.

Albert G. H. Dietz has been appointed Acting Head of the Course in Building Engineering and Construction at the Massachusetts Institute of Technology. Dr. Dietz will succeed **Walter C. Voss,** who retires in June but who will remain at the Institute as Professor Emeritus and Lecturer. Both Messrs. Dietz and Voss have been very active in ASTM technical and administrative activities, also in the New England District Council.

O. B. J. Fraser, Assistant Manager, Development and Research Div., The International Nickel Co., New York City, was hospitalized for some time in April following an automobile accident. It is gratifying to note that he is making good recovery, and expecting to be back at his desk the latter part of May.

Glenn C. Friedly, formerly with Twinsburg-Miller Corp., Twinsburg, Ohio, has accepted a position with C. W. Poe Co., Cleveland.

Truman S. Fuller, for many years Engineer of Works Laboratory, General Electric Co., Schenectady, N. Y., retired on April 30 from long and active service with his company. A Past-President of the Society who will continue as a Member of the Board of Directors for another two years, he has been extremely active in many phases of ASTM work, notably as chairman from 1926 to 1940 of Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys. His numerous technical committee contacts have included A-1 on Steel, A-5 on Corrosion of Iron and Steel, B-2 on Non-Ferrous Metals and Alloys, and many other of the ferrous and nonferrous groups, also a number in the miscellaneous group, and the Joint Committee on Definitions of Terms Relating to Heat Treatment of Metals. Mr. Fuller plans to establish a consulting metallurgical practice, and will maintain an office as a consultant at his home, 2131 Grand Blvd., Schenectady 9, N. Y. In his work with General Electric Co. he has been concerned with many problems involving both ferrous and nonferrous metals, especially those involving power-generating equipment.

Samuel Garber is now in charge of standardization, Office of Standardization, Defense Supply Management Agency, Washington, D. C. For the past two years he has been at the Engineer Research and Development Labs., Ft. Belvoir, Va., serving as Chief, Chemical Engineering Section, Specifications Branch.

C. M. Howard retires on May 31 from active management as Engineer-Manager with the Concrete Products Association of Washington, completing twenty-four years

(*Continued on p. 68*)

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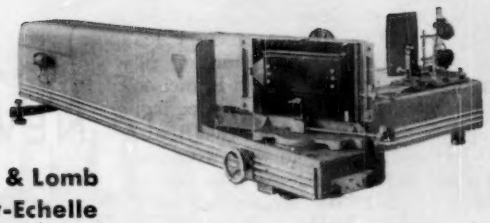

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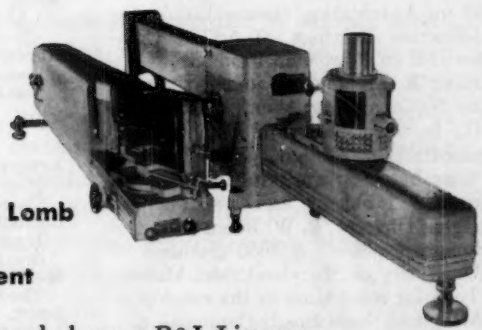

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(*Continued from p. 66*)

of service. He will serve as a consultant to the Association and be available to other clients in a similar capacity. Mr. Howard has been serving on ASTM Committee C-13 on Concrete Pipe, and has been a member of the Technical Problems Committee of the American Concrete Pipe Assn., also has been an active participant in many technical groups in the Seattle area. W. Stephen Callender will succeed Mr. Howard. A 1948 graduate of the University of Washington in Civil Engineering, Mr. Callender has gained engineering experience with the Crown Zellerbach Corp., the City of Seattle Engineering and Light Departments, and the W. H. Witt Co., Seattle structural engineers.

J. D. Malcolmson, well-known packaging specialist, has relinquished his duties as manager of the Products Development Department of Robert Gair Co., Inc., New York City. He will remain on Gair's staff and continue to represent the company on various committees on which he has been serving. In addition, he expects to open an office in San Francisco and do consulting work on packaging. He will reside at 930 Grisley Peak Blvd., Berkeley, Calif., where he recently completed a new home. Active in many technical societies, Mr. Malcolmson has been affiliated with ASTM for many years, serving on Committees D-6 on Paper and Paper Products and D-10 on Shipping Containers.

Samuel A. McKee, Chief, Lubrication Section, National Bureau of Standards, retired recently after 32 years of service with the Bureau. A prominent specialist in the field of lubrication, Mr. McKee, as Chief of the NBS Lubrication Section, has been responsible for the Bureau's basic and applied research in engines and lubrication. A member of many technical organizations in his field, he has been active in the Committee on Fundamental Tests for Lubricating Grease Employing Anti-Friction Bearings, of ASTM Committee D-2 on Petroleum Products.

Arthur B. Mobley has joined the staff of the National Slag Assn., Washington, D. C., in the capacity of Engineer and Administrative Assistant. He will divide his time between work in the field on engineering problems and assisting the Managing Director, **E. W. Bauman,** in the headquarters office. A 1950 graduate of the University of Maryland, Mr. Mobley had been for some time in the employ of the Maryland State Roads Commission.

C. L. Norton, Jr., formerly Technical Director, Refractories Div., The Babcock & Wilcox Co., New York City, has been named Executive Assistant, in charge of all development and engineering activities.

W. H. Rowand, Chief Engineer of the Boiler Div. of The Babcock & Wilcox Co., New York City, has been elected a Vice-President of the company. He will continue to hold the post of Divisional Chief Engineer.

Ralph A. Schaefer has become Vice-President in Charge of Materials Development at Clevite-Brush Development Co. Mr. Schaefer has been Director of Research at the Cleveland Bronze Co., which like Clevite-Brush is a unit of the Clevite group of companies.

Leonard Shapiro has accepted a position on the research staff of the American Polymer Corp., Peabody, Mass. He was formerly Research Director, Synthron, Inc., Ashton, R. I.

Earl R. Stivers, Director, Packaging Research Laboratory, Rockaway, N. J., has been named Chairman of the Forest Products Research Society's Committee on Packaging.

Ferruh Taskin, who has completed two years' laboratory practice at the Institut für Bauforschung, Stuttgart, Germany, has returned to Istanbul, Turkey, as Instructor at the Malzeme Laboratuari, Teknik University.

Norman B. Tichenor, formerly Vice-President in Charge of Sales, Prairie States Oil and Grease Co., Danville, Ill., is now Vice-President, Mineral Solvents Co., Chicago.

Richard C. Ulmer, well known in the power field as a feedwater specialist, and for the last seven years Technical Director of E. F. Drew & Co., has joined the Engineering Department of Combustion Engineering-Superheater, Inc., New York City, where he will be engaged in development work.

Fred Wehmer has accepted a position as Technical Sales Director, Rubber and Asbestos Corp., Bloomfield, N. J. He was formerly associated with the Minnesota Mining and Manufacturing Co., St. Paul, Minn., as Chemical Engineer.

George J. Wyrough, for a number of years Technical Salesman, R. E. Carroll, Inc., is now a member of the recently formed partnership of Wyrough & Loser, Trenton, N. J.

NEW MEMBERS. . . .

The following 92 members were elected from March 19 to April 23, 1953, making the total membership 7484 . . . Welcome to ASTM

Note—Names are arranged alphabetically—company members first then individuals

CHICAGO DISTRICT

Lehigh Sewer Pipe and Tile Co., Joseph A. Bryant, Production Superintendent, Lehigh, Iowa.

Morgan, Howard T., President, John R. MacGregor Lead Co., 4520 W. Fifteenth St., Chicago 23, Ill.

Price, Warren R., Technical Director, Central Waxed Paper Co., 5100 W. Roosevelt, Chicago 50, Ill.

Royce, Clinton K., Proprietor, Clint Royce Associates, 2641 E. Beverly Rd., Milwaukee 11, Wis.

CLEVELAND DISTRICT

Betterton, James S., Vice-President, Air-Way Insulation Co., 11301 Superior Ave., Cleveland 6, Ohio.

Buchman, E. L., Manager, Quality Control Dept., Ford Motor Co., Cleveland Foundry, Box 309, Berea, Ohio.

Markee, Charles A., Development Chemist, The Ohio Boxboard Co., Rittman, Ohio.

Smith, Sterling, President, The White Rubber Co., Ravenna, Ohio. For mail: Box 413, Ravenna, Ohio.

DETROIT DISTRICT

Brilmyer, Harold G., Vice-President in Charge of Research, Huck Manufacturing Co., 2480 Bellevue Ave., Detroit 7, Mich. For mail: 707 St. Clair, Apt. C, Grosse Pointe 30, Mich.

Meniru, Godwin Ude, Plant Engineer, Willys-Overland Motors, Inc., Toledo 1, Ohio. For mail: 1924 Forest St., Toledo 6, Ohio.

Morrison, Harry, Consulting Engineer, Cycleweld Cement Products Plant, Division of Chrysler Corp., 5437 W. Jefferson, Trenton, Mich.

NEW ENGLAND DISTRICT

American Bosch Corp., F. A. Lindquist, Supervisor, Engineering Records, Springfield 7, Mass.

Allen, Howard H., President, Nonotuck Manufacturing Co., Holyoke, Mass.

Jordan, Merrill E., Research and Development Dept., Godfrey L. Cabot, Inc., 38 Memorial Dr., Cambridge 42, Mass.

Morey, Reginald H., Boston District Manager, Pittsburgh Testing Lab., 101 Tremont St., Boston 8, Mass.

Nelson, Joseph S., Research Group Leader, Monsanto Chemical Co., Springfield, Mass.

Parker, Edward A., Technical Director, Technic, Inc., 39 Snow St., Box 965, Providence 1, R. I.

Roth, H. P., Staff Member, Massachusetts Institute of Technology, Hood Bldg., 155 Massachusetts Ave., Cambridge 39, Mass.

Tiers, Robert H., Chief Chemist, W. D. MacDermid Chemical Co., 81 Main St., Bristol, Conn.

Walters, Howard G., Belting Engineer, Russell Manufacturing Co., Middletown, Conn. [J]

NEW YORK DISTRICT

Anti-Corrosive Metal Products Co., Inc., Edith A. Cameron, Purchasing Agent, Box 870, Albany, N. Y.

Bendix Aviation Corp., Utica Div., R. C. Gibbons, Chief Metallurgist, 211 Seward Ave., Utica, N. Y.

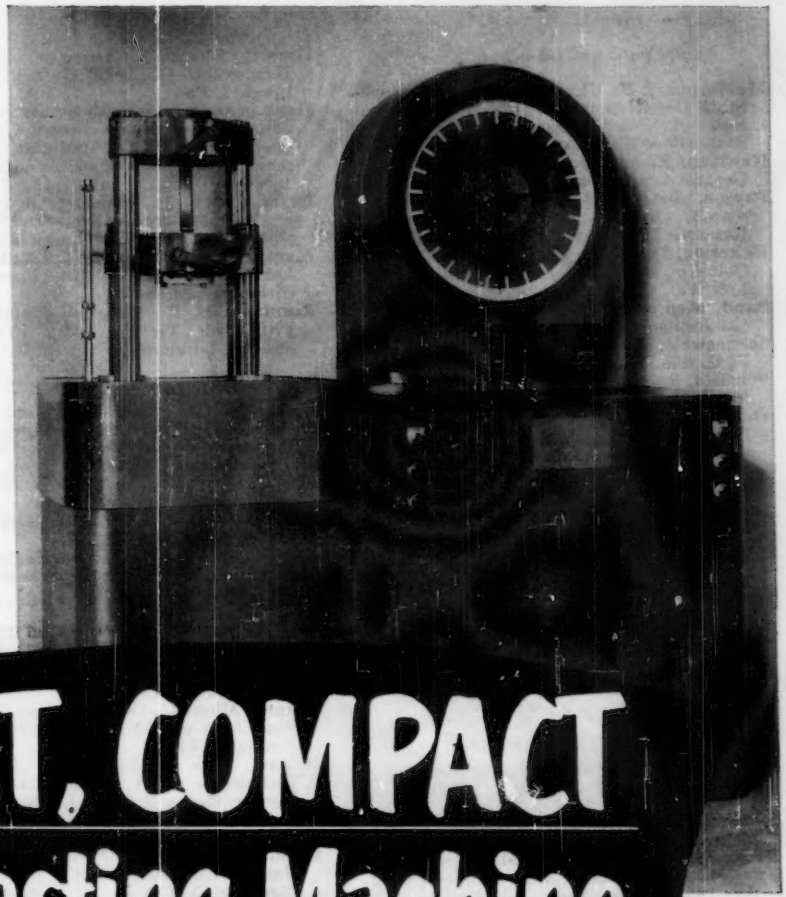
Beyer, Vernon F., Member of Firm and Director of Sales, Bryton Chemical Co., Box 418, Marcus Hook, Pa. For mail: R.D. 1, Box 500, Matawan, N. J.

Gobus, Alexander, Director, Non-Destructive Testing, North American Philips Co., Inc., 750 S. Fulton Ave., Mt. Vernon, N. Y.

Lenel, Fritz V., Associate Professor, Department of Metallurgical Engineering, Rensselaer Polytechnic Inst., Troy, N. Y.

(*Continued on p. 70*)

Universal Testing Machine Model 60-H with T.E.G. load indicator



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(*Continued from p. 68*)

McMorran, J. B., Chief Engineer, New York State Department of Public Works, Division of Construction, Thirteenth Fl., State Office Bldg., Albany 1, N. Y.
Newman, Richard J., The Daven Co., 191 Central Ave., Newark 4, N. J.
Payson, Peter, Assistant Director of Research, Crucible Steel Co. of America, Research Laboratory, Harrison, N. J.
Pickering, Lenox K., Chief Engineer, Pepsi-Cola Co., 46-02 Fifth St., Long Island City 1, N. Y.
Rand, Maurice, Owner, Maurice Rand Co., 131 Joralemon St., Brooklyn 1, N. Y.
Schneeweis, Basil, The Firth Carpet Co., Firthcliffe, N. Y.
Warfield, Robert, Research Chemist, Bristol-Myers Co., 225 Long Ave., Hillside, N. J.
Young, Melvin H., Director, Engineering Product Services, Wright Aero Div., Curtiss-Wright, Wood Ridge, N. J.

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California State Department of Public Works, Division of Architecture, Area I, Box 1229, Oakland, Calif.
California State Department of Public Works, Division of Architecture, Area II, Box 1079, Sacramento, Calif.
Dickinson, Maurice L., Chief Hydraulic Engineer, Bechtel Corp., 4620 Seville Ave., Los Angeles 58, Calif.
Langford, Daniel B., Technical Director, Novoply Div., Shasta Plywood Corp., Box 1688, Redding, Calif.

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Akers, J. R., Chief Corrosion Engineer, Reynolds Metals Co., 2500 S. Third St., Louisville, Ky.
Harman, Cameron G., Ceramic Engineer, 5365 Linworth Rd., Worthington, Ohio.
King, Charles P., District Manager, Pittsburgh Testing Lab., 3821 E. New York St., Indianapolis, Ind.
Mathewson, M. E., Executive Vice-President, A. M. Kinney, Inc., 2905 Vernon Place, Cincinnati 19, Ohio.
Protzman, W. G., Product Engineer, West Virginia Steel and Manufacturing Co., Box 118, Huntington 6, W. Va. For mail: 2010 Cherry Ave., Huntington, W. Va.
Van Lehn, Robert B., Quality Control Chemist, Vernay Laboratories, Inc., Yellow Spring, Ohio.
Ward, Edward J., Chief, Fatigue Section, Materials Lab., U. S. Department of the Air Force, Wright Air Development Center, Wright-Patterson Air Force Base, Ohio. For mail: 419 Talbott Dr., Dayton 9, Ohio.
Wiethe, Louis, Jr., Chemist, Kutol Products Co., 2817 Highland Ave., Norwood, Cincinnati, Ohio. [J]

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Kiwi Polish Co., Pty., Ltd., The, Lawrence Emley, President, American Div., 836–44 S. Swanson St., Philadelphia 47, Pa.
Bowe, Arthur F., Laboratory Coordinator, E. I. du Pont de Nemours & Co., Petroleum Chemicals Div., Wilmington 98, Del.
Cooper, Frederick, Chief Metallurgist, Fairmount Steel Corp., 3720 Main St., Philadelphia 27, Pa.
Philadelphia, City of, Department of Licenses and Inspections, D. T. Anderson, Administrative Assistant, Board of Building Standards, 225 City Hall Annex, Philadelphia 7, Pa.
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Walker, William G., Engineer in Charge of Testing Section, Philadelphia Electric Co., 2301 Market St., Philadelphia 3, Pa.

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Auchmuty, R. Laird, Partner, Eavenson & Auchmuty, 2720 Koppers Bldg., Pittsburgh 19, Pa.
Brooks, George C., Preparation Engineer, Freebrook Corp., Kittaning, Pa. For mail: R.D. 1, Box 42, Punxsutawney, Pa. [J]
Corbett, Robert B., Director of Research, Heppenstall Co., 4620 Hatfield St., Pittsburgh 1, Pa.
Danko, Andrew W., Materials Engineering Dept., Westinghouse Electric Corp., Braddock Ave., East Pittsburgh, Pa. For mail: 2404 Woodstock Ave., Pittsburgh 18, Pa.
Evans, Alan S., Jr., Manager, Coal Chemicals Div., Pittsburgh Coke and Chemical Co., Grant Bldg., Pittsburgh 30, Pa.
Marcy, V. M., Research Engineer, Hall Laboratories, Inc., 323 Fourth Ave., Pittsburgh 22, Pa.
Rosumny, M. R., Manager, Metals Section, Pittsburgh Testing Lab., 1330 Locust St., Pittsburgh, Pa.

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Gleser, Sol M., Supervising Civil Engineer, U. S. Department of the Army, Corps of Engineers, Upper Mississippi Valley Div., P.O. Drawer 3, Central Station, St. Louis 1, Mo.
Koenig, Joseph J., Gaylord Container Corp., Research and Development Div., 2820 S. Eleventh St., St. Louis, Mo.
Turner, Joe S., Materials Engineer, The Coleman Co., Inc., St. Francis and Second Sts., Wichita 1, Kans.

SOUTHERN CALIFORNIA DISTRICT

California State Department of Public Works, Division of Architecture, Area III, Box 511, Los Angeles 53, Calif.
Chaney, Albert L., Owner, Albert L. Chaney Chemical Lab., 1503 E. Chevy Chase Dr., Glendale 6, Calif.
Doman, John J., Laboratory Mechanical Technician, U. S. Naval Civilian Engineering Research and Evaluation Lab., Port Hueneme, Calif. For mail: Route 2, Box 481B, Comarillo, Calif.
Moudry, G. A., Chief Metallurgist, Harvey Machine Co., Inc., 19200 S. Western Ave., Torrance, Calif.
Sjogren, C. Norman, Division Head, Consulting and Research, C. F. Braun & Co., 1000 S. Fremont Ave., Alhambra, Calif.

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Mathieson Chemical Corp., Norman C. Schultze, Technical Representative, Mathieson Bldg., Baltimore and Light Sts., Baltimore 3, Md.
Hanrahan, Frank J., Executive Vice-President, American Institute of Timber Construction, Suite 100, 1757 K St., N. W., Washington 6, D. C.
Kahn, Marvin J., Chief Structural Engineer, Aircraft Armaments, Inc., Box 1777, Baltimore 3, Md.
Speight, Frank Y., Assistant to Executive Director, Advisory Board on Quartermaster Research and Development, National Research Council, 2101 Constitution Ave., N. W., Washington 25, D. C.

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Katherine Rug Mills, Said Shaheen, Partner, 429 S. Green St., Dalton, Ga.
Barker, L. J., Specification Engineer, Kaiser Aluminum and Chemical Corp., Box 1451, Spokane 10, Wash.
Brennan, James J., Consultant, Brennan Associates, 216 Cedar St., Hot Springs, Ark.
Couch, Bartlett L., District Manager, Pittsburgh Testing Lab., 2419 S. E. Powell Bldv., Portland 2, Ore. For mail: 2112 N. E. Eighty-first Portland 13, Ore.
Curtin, A. T., Manager, Pittsburgh Testing Lab., 4301 N. W. Seventh St., Miami 34, Fla.
Harte, John J., President, John J. Harte Co., Box 2192, Atlanta 1, Ga.
Moench, W. Lynn, Assistant to President, Tennessee Tufting Co., 2404 Heiman St., Nashville, Tenn. [J]
Morris, Robert W., Engineer, Cinder Concrete Products, Inc., 1155 W. Fifth Ave., Denver 4, Colo.
Seybold, R. C., Manager, Birmingham District, Pittsburgh Testing Lab., Pittsburgh, Pa. For mail: 900 Sixth Ave., N., Birmingham 4, Ala.
Tautz, Herbert E., Consulting Engineer, Heckethorn Manufacturing Co., Littleton, Ohio. For mail: 1201 E. First Ave., Denver, Colo.
Welch, William L., State Chemist, Oklahoma Corp. Commission, Capitol Office Bldg., Oklahoma City, Olka. For mail: Box 6231, Oklahoma City, Okla.

OTHER THAN U. S. POSSESSIONS

Ishikawajima Heavy Industries Co., Ltd., Hajime Nakamura, Manager of Technical Research Lab., 54, Tsukudajima, Chuo-ku, Tokyo, Japan.
Acosta Lagunes, Josefina, Laboratory Head, Sosa Texcoco, S. A., V. Carranza 54, 7° Piso, Mexico 1, D. F., Mexico.
Canals, Felix Capella, Chief Chemist, Cementos Tanger, S. A., 20 Rabat Rd., Tangier, Morocco. For mail: Mejico 51, Tangier, Morocco.
Johnson, Warren Cottle, Materials Engineer, Materials Testing Lab., Base Development, Box 126, Agana, Guam.
MacPhee, William M. W., Industrial Engineer, 6-3-chome Nihonbashi Hongokucho Chuoku, Tokyo, Japan.
Thailand, Department of Science, Rama VI Road, Bangkok, Thailand.

* J denotes Junior Members.

DEATHS...

FRANK HART ALCOTT, Building Codes Consultant and Structural Engineer for the National Lumber Manufacturers Assn., died at his home in Jamaica, N. Y., March 16, 1953, following a heart attack. He was 62. Employed by NLMA as consulting engineer on building codes for the Northeast since 1940, Mr. Alcott had represented NLMA on several ASTM groups, including Committees D-7 on Wood, E-5 on Fire Tests of Materials and Construction, and E-6 on Methods of Testing Building Constructions. He also had served on ASA Sectional Committees on Specifications for Fire Tests of Materials and Construction, and on Specifications for Plastering. A native of Brooklyn, Mr. Alcott was a graduate (1915) of Rensselaer Polytechnic Inst., Troy, N. Y.

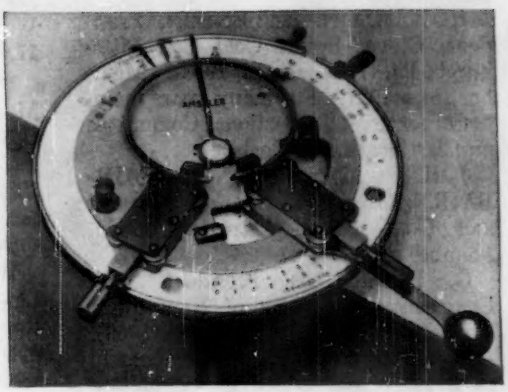
A. P. BEREJKOFF, Electronics Dept., Commercial Equipment Div., General Electric Co., Syracuse, N. Y. (Suddenly in Miami, Fla., March 19, 1953). Representative of Radio-Television Manufacturers Assn. on Committee D-20 on Plastics since 1937.

C. G. CASHION, Xylos Rubber Co., Akron Ohio (April 9, 1953). Representative since 1945 of The Firestone Tire and Rubber Co. on Committee

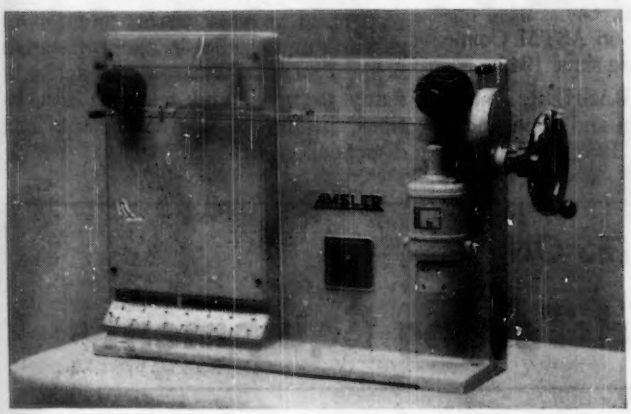
(*Continued on p. 72*)

AMSLER TESTING EQUIPMENT

New Buehler Catalog now available on request. 200 pages—a comprehensive catalog of Buehler equipment for the metallurgical laboratory.



THE PISTON RING TESTER measures the force required to open or close the ring and operates practically without friction. The bending moment is distributed over the entire circumference of the ring. A simple formula converts to lateral pressure against the cylinder wall. The instrument may be used to determine the maximum bending moment at fracture. It can accommodate rings from 2 to 6 inches diameter and has 5 ranges of 10, 20, 50, 100 and 200 inch pounds.



THE SMALL TENSILE TESTER is designed to accommodate wires, twine, thread, narrow ribbons, etc. of small tensile strength. Four ranges of 10, 20, 40 and 60 pounds are provided on the smallest model. A 100 pound and a 120 pound model are also available. The sample is wound around drums, one of which is the axis of the dependable pendulum measuring system. The other drum can be rotated by hand or motor drive. The gripping length is 18 inches. Extensometers of the simple or magnifying type are available.

THE PAINT AND VARNISH TESTER makes a cup impression on a sheet of metal which has been painted with the material being tested. The depth of the cup before the coating cracks and the size and shape of the fissures are indicative of some of the qualities of the paint. The sample is held in a die and a plunger pressed into it from below by turning the handwheel. A dial indicates the height of the cup. A microscope provides for examination of the progress of the test.

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Adolph I. Buehler

OPTICAL INSTRUMENTS

228 NORTH LA SALLE ST., CHICAGO 1, ILLINOIS

(*Continued from p. 70*)

D-11 on Rubber and Rubber-Like Materials, and of Xylos Rubber Co. (a Firestone subsidiary) on SAE-ASTM Technical Committee on Automotive Rubber. He served as Vice-Chairman of the latter committee for some time, and had been particularly active in Section IV on Classification and Specifications of Automotive Rubber Compounds, heading the subgroup concerned with Low-Temperature Properties of Elastomers. Although Mr. Cashion had not been well for some months, his death was unexpected and quite sudden, resulting from a severe heart attack.

HOWARD N. EAVENSON, President, Clover Splint Coal Co., Pittsburgh, Pa. (February 16, 1953). Member since 1921. For many years member of former ASA Sectional Committee on Classification of Coals.

JOHN MACFARLANE FAIRBAIRN, President, Charles Warnock and Co., Ltd., Montreal, Canada. Member since 1938.

G. B. GOULD, President, Fuel Engineering Company of New York, New York City (March 20, 1953). Representative of company membership since 1928, and active in Committee D-5 on Coal and Coke and many of its subgroups since 1937, serving for many years as Chairman of Subcommittee XVII on Significance of Tests.

GEORGE B. HAVEN, Professor Emeritus of Machine Design, Massachusetts Institute of Technology, Cambridge, Mass. (March 6, 1953). Member since 1917, and for many years active in the deliberations of Committee D-13 on Textile Materials, serving as second chairman of the committee (1917–1920), and on a number of subgroups including the Advisory Committee, and for some time heading the Section on Humidity. In recognition of valued contributions he was made an honorary member of Committee D-13 in 1936.

EMIL SCHAEFFER, Chief Engineer, Tower Div., Elizabeth Iron Works, Elizabeth, N. J. (November 17, 1952). Member since 1951.

FREDERICK D. SCHREIBER, Manager, Coal Chem. Div., Pittsburgh Coke and Chemical Co., Neville Island, Pa. (March 22, 1953). Member since 1952, and representative of the American Coke and Coal Chemicals Institute since 1951.

W. C. SWARTOUT, Missouri Pacific Lines, St. Louis, Mo. (March, 1953). Representative of the American Railway Engineering Assn., Committee on Roadway and Ballast, on ASTM Committee C-4 on Clay Pipe since 1940.

GRAFTON M. THRASHER, Foundry Engineer, R. Lavin and Sons, Inc., Chicago, Ill. (April 10, 1953). Member of Society since 1939, and of Committee B-5 on Copper and Copper Alloys, and its Subcommittee on Castings, and Ingots for Remelting since 1942.

JOHN F. TINSLEY, Vice-President and General Manager, Crompton & Knowles Loom Works, Worcester, Mass. (November, 1952). Member since 1912.

JAMES R. WITHROW, Emeritus Professor of Chemical Engineering, Ohio State University; and Consulting Chemical Engineer and Mineralogist, Columbus, Ohio (March 30, 1953). A member of the Society since 1929 and of several of the technical groups, his ASTM activities were concentrated mainly in Committees C-7 on Lime and C-12 on Mortars for Unit Masonry. In the former group he served as Chairman, 1932–1940, and made many important contributions. Born in Philadelphia in 1878, Professor Withrow was a graduate of the University of Pennsylvania. His first position was with the Barrett Mfg. Co., where he had charge of the general testing and research laboratory. He became a member of the faculty of Ohio State Engineering Department in 1906. Widely recognized as an educator and for his research and studies in many materials fields, Professor Withrow was active in many technical and scientific associations, heading many committees and discussion groups.

NEWS NOTES ON
Laboratory Supplies and Testing Equipment

Instrument Notes

New Portable Six-Channel Oscillograph—A new portable six-channel oscillograph, designed for use where the need for a lightweight, compact, and portable instrument is of prime importance has been announced. Known as Model BL-226 Oscillograph, it is equipped with six Model BL 902A Penmotors which permit the simultaneous recording of six channels of instantaneous electric phenomena, or mechanical phenomena that can be converted to electrical phenomena in the frequency range of dc to 100 cycles per sec. A large window in the top of the instrument permits viewing the chart as information is being recorded. Controls provide starting, stopping, and selection of chart speeds of 5, 25, and 125 mm per sec. A 25-ft length of cable and junction box provide all the necessary outlets for connecting six Brush Amplifiers to the Oscillograph. A remote control box is provided as an accessory, permitting the operator to start and stop the chart drive from remote locations. Outlets are provided in both the oscillograph and control box to permit use of a floor switch.

Brush Electronics Co., Equipment Div., 64H, 3405 Perkins Ave., Cleveland 14, Ohio.

New Laboratory Instruments—A new device for studying the behavior of the transistor has been announced by the Electronic Instruments Div. of Burroughs Adding Machine Co. This laboratory instrument, called the "Alphabetameter," was created to perfect transistor performance. The Alphabetameter is one of several products now offered for scientific use by Burroughs. Also recently introduced was a new type of tube which forms, controls, and switches electronic beams so that they will perform many different jobs. Burroughs beam-switching tubes may be used as components in airborne telemetering and communication systems, business machines, and large electronic computers.

Burroughs Adding Machine Co., Box 418, Detroit 32, Mich.

New Oil Diffusion Pump—A new oil diffusion pump known as the Cenco Supervac OD-25 has been announced by Central Scientific Co. It is said that this pump is exceptionally easy to take apart for cleaning and may be quickly connected or disconnected. The unit consists of only three basic parts: the jet manifold, the jacket, and the boiler with its detachable heater. The jet manifold, which is a three state unit of welded steel, fits snugly in the boiler compartment and is completely enclosed by the jacket. Six Allen screws hold the jacket and boiler together and a synthetic rubber "O" ring provides a vacuum-tight seal. By loosening these six cap screws, the three parts come apart for inspection, draining, cleaning, and filling. The pump is attached to the vacuum system by means of the new Cenco "O" ring connectors with the result that it may be disconnected or reconnected in a few moments, always with a vacuum-tight seal. The Cenco Supervac OD-25 Oil Diffusion Pump is based on the principle of entrapping gas or air molecules by a stream of oil vapor, the oil being vaporized by the application of heat. As oil molecules leave the surface of the oil in the boiler, they are forced upward through a vertical column where they are deflected downward and outward at sonic velocities

(*Continued on p. 74*)

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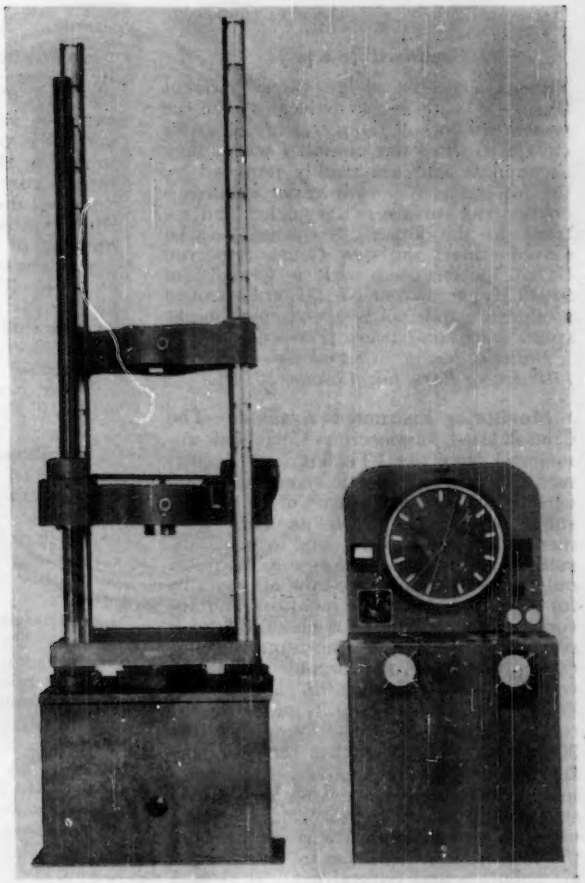

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(*Continued from p. 72*)

through jets placed at three different levels. The air or gas molecules from the system are swept along by the oil vapor stream to the lower chamber where they accumulate and are readily removed by the forepump. The oil vapor condenses on the cool surface of the jacket and returns to the boiler. According to the manufacturer, the new Cenco Supervac OD-25, when used with a Cenco No. 92045 Hypervac-4 or No. 90550 Pressovac as the forepump, obtains extremely high-speed evacuation at low pressures.

Bulletin No. 12, Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.

Monitoring Instrument Available—The Consolidated Engineering Corp. has announced that the "Titrilog," an instrument for the automatic, continuous recording of concentrations of oxidizable sulfur compounds such as H_2S, SO_2, mercaptans, thioethers, and organic disulfides in gas streams, formerly available only on a lease basis, is now offered also for sale. The Titrilog monitors and records sulfur compounds such as hydrogen sulfide, sulfur dioxide, mercaptans, thioethers, thiophene, and organic sulfides in concentrations as low as 0.1 part per million or 0.005 grain per cu ft, and will indicate a change in concentration in less than 30 sec. It is claimed that this response speed, when carefully monitored or when installed with an alarm device, allows safe, sufficient time to correct the condition causing alarm. Applications vary, two of the most prominent being in the fields of air pollution and natural gas. It is said that the instrument is ideally suited for monitoring sulfur dioxide and hydrogen sulfide in the atmosphere, and can be used in the natural gas industry to record odorant levels, to determine corrosive sulfur concentrations, for use with blending operations, and in the treatment of high-sulfur gases. Two models are offered: the 26-102 for laboratory or plant as a semipermanent installation, and the 26-103, portable and easily transportable for both plant and field use.

Bulletin CEC-1826, Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 15, Calif.

Counting System—A conventional Geiger counting instrument used for counting radioactive particles has recently been announced by Detectolab, Inc. This instrument is made from three separate "Electronic Building Blocks" each block being only 5¼ by 19 in. in size. According to the manufacturer, any of the blocks can be removed and used in other instrument combinations. If work requires a conventional scaler as described and scintillation counting needed later, an additional block can be added to the scaler and work started immediately and if a Counting Rate Meter is needed, another block is added.

Detectolab, Inc., 6544 Sheridan Rd., Chicago 26, Ill.

Direct-Reading Instrument for Tetraethyl Lead in Gas—An electronic "TEL-Meter" reading directly in milliliters of "TEL" per gallon of gas, has been announced by the Fisher Scientific Co. Calibrated to report 0 to 5 ml of TEL per gallon of gasoline, the instrument is said to be as accurate as the slow gravimetric method traditional in this determination. The TEL-Meter eliminates variables through a "pilot" ion. The pilot ion is cadmium, put in the solution in known concentrations. Its current is governed by the same factors governing the lead current. Thus, when the *ratio* of the two currents, lead to cadmium, is taken, all variables cancel out. The TEL-Meter measures the two currents, takes their ratio, figures the lead concentration, and reports it directly in ml of TEL per gallon. Operation is simple involving merely the pressing of four buttons, the turning of four knobs until the galvanometer balances at zero. The TEL-Meter, comes complete with polarographic cell, capillary, leveling bulbs, batteries, control box, and all connectors. Dial lamp runs on a transformer from 115 v 50–60 cycle ac.

Fisher Scientific, 717 Forbes St., Pittsburgh 19, Pa.

New Small Type Tilter—A new tilter designed to meet the needs for a smaller, more simplified, less expensive unit suitable for handling 5 and 6½-gal containers has been announced by General Scientific Equipment Co. According to the company, this unit, known as the GS No. 49 tilter, prevents accidents caused by spilling, splashing, and carelessness in pouring liquids. A chain is provided to hold the container in position when tilted. The pouring spout assures a smooth flow without spurts or splashes. Made of acid-resistant rubber and plastic tubing for longer life. Fits openings from 1 to 1¾ in. with a flow capacity of slightly more than 1 gal per min.

General Scientific Equipment Co., 2700 W. Huntingdon St., Phila. 32, Pa.

New High Temperature Rectipot Model 8620—A new linear motion potentiometer, the Model 8620 Rectipot, has recently been introduced. Standard models will operate in a temperature range of −55 to +71 C and a new high temperature model will operate in a temperature range of −55 to +149 C. These new Rectipot potentiometers can be had with either one or two electrically independent resistance units, both operated from the same shaft. Linear strokes of from 0.5 to 5.25 in. are available and the shaft is free to rotate through 360 deg. Designed to operate with only a small actuating force, it is claimed that the Rectipot can deliver an output signal proportional to small mechanical displacements. These precision potentiometer units are manufactured with total resistances ranging from 400 ohms per in. to 15,000 ohms per in. of stroke. Additional stroke ranges and resistances are available on special order.

G. M. Giannini & Co., Inc., 117 E. Colorado St., P.O. Box N, Pasadena 1, Calif.

Radio Frequency Heating Provides New Method of Measuring Both Carbon and Sulfur in Iron and Steel from One Sample—According to a recent announcement, carbon and sulfur contents in all types of ferrous alloys can be determined by means of a newly developed procedure introduced by the Laboratory Division of Lindberg Engineering Co. The new unit, which employs radio frequency inductive heating, tests for both carbon and sulfur in a single operation in 10 min, representing a time saving of 22 to 25 min over conventional methods. The Lindberg High Frequency Combustion Unit is capable of heating samples to temperatures above 3000 F, higher than previously practical with resistance element furnaces. Heat is generated only in the relatively small metal sample. Thus, tubes, crucibles, and other adjacent parts are heated only by conduction or radiation from the comparatively small mass of the sample.

Lindberg Engineering Co., Laboratory Div., 2450 Hubbard St., Chicago 12, Ill.

New Type Precision Balance—The Ohaus Scale Corp. announces a new type balance featuring a micrometer poise. This poise enables the balance to be used for a range from 0.5 to 1000 g without additional weight. The poise is designed so that it may be slid along the beam for rapid traverse and rotated for final positioning. The poise barrel is calibrated in 0.5-g increments which subdivide the 10-g beam divisions. The balance is equipped with 7-in. diameter stainless steel plates and etched aluminum graduated beam. The capacity is 5000 g, sensitivity 0.5 g. As an additional feature, the balance has an undivided tare beam of 1 lb capacity. Self-aligning bearings are of agate and knife edges of precision hollow-ground tool steel. Balance beam is of light weight, high-strength duralumin, thus rendering maximum inherent sensitivity. In place of the flat stainless steel plates illustrated, the balance can be furnished with two 9-in. diameter nickel-plated brass pans; or a seamless brass scoop 15 by 7½ by 7¼ in. and stainless steel weighing platform.

Ohaus Scale Corp., 1050 Commerce Ave., Union, N. J.

New Microscope-Metallograph—A newly designed metallurgical microscope and metallograph, the "CSF," has been announced by Opplem Co., importers. The unit occupies only one tenth to one twentieth of the space normally taken by instruments used for this type of work. Group observation of the specimen is also made possible by projecting the light beam through the camera housing onto a screen. The CSF is said to feature sharp, brilliant, visual observation at all magnifications up to 1000× and photographic and projection observation up to 1500×. A 2½ by 3½-in. reflex camera is supplied which takes both plates and roll film. The CSF is provided with two dry objectives for low and medium magnifications and one oil immersion objective for high magnifications. All are individually mounted and centered on interchangeable slide holders. It is claimed that they are supplied in the standard ASTM magnifications of 50×, 75×, 100×, 200×, 500×, 1000×, and 1500×. Intermediate values are available. It has both a rack and pinion device for coarse focusing and a micrometric movement for fine focus registering to 2 μ. Seven interchangeable photographic lenses are supplied to cover the full range of magnifications up to 1500×. Exact focusing of the reflex camera is done on the horizontal ground-glass screen and a precision-built shutter provides time, bulb, and a wide range of exposure from 1 to $^1/_{250}$ sec. Photographs on plate or film are taken by raising the reflecting mirror and releasing the shutter.

Opplem Co., Inc., 352 Fourth Ave., New York 10, N. Y.

New High-Speed Magnetic Tape Handler—A new high-speed, Magnetic Tape Handler for digital data handling and general computer recording and playback has been announced by the Potter Instrument Co., Inc. Suggested uses include sorting and collating business information, data reduction, high-speed recording of scientific phenomena, digital telemetering, and subscription list processing. Accord-

(*Continued on p. 76*)

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(*Continued from p. 74*)

ing to the manufacturer, one feature of the device is its ability to start and stop intermittently within 5 milliseconds from external signals thus making it possible to record, play back, or compare blocks of information. Fully reversible drive at speeds of 15 and 30 in. per sec is provided. New photoelectric proportional servo tension controls provide uniform tape tension over the recording head at all speeds. Two models are in production, the 901A for ½-in. tape provides six-track recording, and the 901B for ¼-in. tape provides two tracks. Other models for one to eleven tracks are available for use with 2400-ft, 10½-in. reels. The equipment is offered without recording or playback amplifiers, or it can be provided with amplifiers specified by the purchaser. The Potter Magnetic Tape Handler is designed for standard 19-in. relay rack mounting, requiring 24½ in. of panel space and 13 in. behind the panel. Power required is 115 v ac, single phase, 400 w.

Potter Instrument Co., Inc., 115 Cutter Mill Rd., Great Neck, N. Y.

Cloud and Pour Test Cabinets—Announcement has been made that the Precision Scientific Co. has redesigned their Cloud and Pour Test Cabinets to produce trouble-free refrigeration for temperatures as low as −90 F. It is claimed that the accuracy and speed of processing tests such as ASTM D 97,[1] API No. 506 and similar tests calling for low-temperature control, have been improved. Two cabinets cover the full range of cloud and pour tests. The three-compartment cabinet operates at +30 F, 0 F, and −30 F, while the two-compartment cabinet operates at −60 F and −90 F. Compartment thermostats are preset and automatically hold temperatures within 2 F. Operational simplicity and a minimum of maintenance service are the prime objectives in the redesign. The cabinets reach operating temperature rapidly; the coldest compartment reaches −90 F in about 2½ hr. According to the company, heavy Rubatex insulation and hermetically sealed joints hold heat losses to a minimum. Safety interlocking wiring prevents compressor damage when starting with a warm cabinet. Cabinet interiors and bath covers are corrosion-resistant polished stainless steel and bakelite.

Bulletin 11304, Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

[1] Method of Test for Cloud and Pour Points (D 97 – 47) 1952 Book of ASTM Standards, Part 5, p. 51.

Volt-Amp Tester—The "Amprobe Junior," a new snap-around volt-amp tester has been announced by the Pyramid Instrument Corp. According to the manufacturer, this snap-around ammeter measures current instantly without shutdowns or ammeter connections. This tester is a voltage meter which gives an accurate voltage reading without guesswork on a full-size 1.8-in. calibrated scale. (Accuracy for both amperage and voltage is ±3 per cent of full scale.) To measure current without ammeter connections, the trigger-operated jaws are snapped around one conductor. To measure voltage the test leads are plugged into the instrument and clipped to load. Other features include: 3-in. d'Arsonval high-torque movement with Alnico 5 magnet. Probe jaws completely insulated, and tapered for "hard to get at" wires.

Pyramid Instrument Corp., Lynbrook, N. Y.

Laboratory Incubators—The Fischman Co., manufacturers of institutional and laboratory equipment, have announced two heavy-duty type laboratory incubators. Both units are of the gravity convection wet type having an automatically controlled temperature range from room temperature to 60 C with not more than 0.5 C variation after working temperature is reached. They are designed to control temperature and humidity of the incubating chamber so that growth of bacteria cultures will not be impaired by the presence of hot or cold spots. Both incubators are fabricated from heavy gage stainless steel. Heating units are of "Nichrome," operating at low wattage and giving off black-heat which is rapidly dissipated, eliminating heat lag or temperature creep. Units designed to operate on either 110 v ac-dc or 220 v ac-dc.

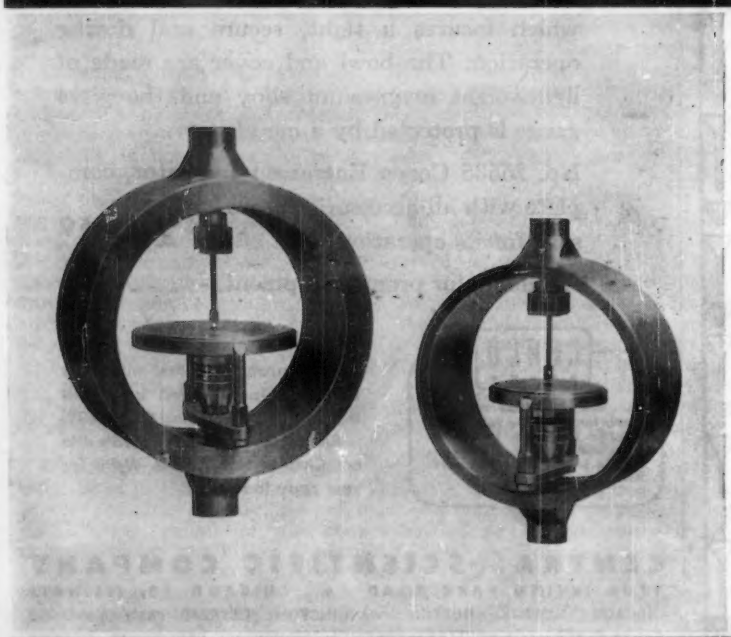
The Fischman Co., Phila. 33, Pa.

Liquid-Level Extractors—A new type of glass apparatus for the extraction and determination of salts of organic bases and acids known as the "Schmall Apparatus" has just been announced. According to the manufacturer, the technique employed eliminates many hand operations. Instead of the conventional method which

(*Continued on p. 78*)

Morehouse

PROVING RINGS FOR WEIGHING FORCES AND CALIBRATING TESTING MACHINES



Proving rings were originally designed to calibrate testing machines. They are still being used for that purpose in many government, educational and industrial laboratories but have also been applied in many installations where accurate weighing is a necessity.

All Morehouse proving rings are calibrated and certified by the National Bureau of Standards.

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100 to 300,000 lbs. or Equivalent in Kilograms	200 to 100,000 lbs. or Equivalent in Kilograms

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for maintaining quality control in the manufacturing of a wide variety of products from all kinds of textiles including many types of synthetics, to printing inks, plastics, wallpaper, and any product subjected to the deteriorating effect of sunlight in use. This machine is also widely used for testing the fading, and resistance to sunlight of many new products now in the process of development. Positive, dependable results can be obtained in the laboratory in a fraction of the time required by any other method of testing. Exact duplication of tests can be made at any time in the process of improving the resistance to sunlight of any product. *Write for complete information and scientific data on the operation of the Atlas Fade-Ometer.*

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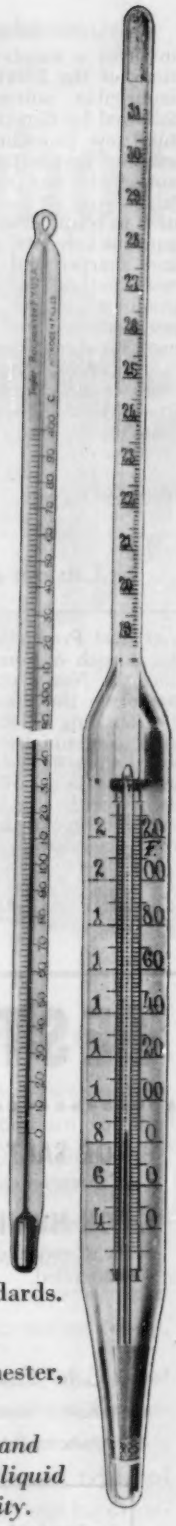
PROMPT DELIVERY on Taylor Etched Stem Thermometers & Hydrometers



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Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.

Taylor Instruments

MEAN

ACCURACY FIRST

IN HOME AND INDUSTRY

(*Continued from p. 76*)

involves a number of individual extractions of the liberated base or acid with immiscible solvents using separators, followed by titration in aqueous medium, this new procedure not only facilitates sample preparation, but extraction is automatic, washings are eliminated, and labor cost of analysis reduced. When used in conjunction with titrations in non-aqueous solvents, transfers are eliminated and sharper end points obtained. The new method may be applied to bulk products as well as to pharmaceutical preparations, and the apparatus may be used for direct saponification and extraction without transfer. Two types of liquid-liquid extractors are available. One is used for use with solvents lighter than water; the other for those heavier than water.

Scientific Glass Apparatus Co., Inc., Bloomfield, N. J.

Catalogs and Literature

Optical Products—Just off the press is the Bausch & Lomb Optical Co. publication, "A New Century," issued to commemorate the hundredth anniversary of the founding of the company. This 16-page, centennial issue presents the viewpoint that a "new century of optical progress" is about to unfold. The early history of the company is discussed; past accomplishments reviewed; methods and techniques employed in the manufacture, research, and design of optical systems explained; optical products listed; and indications given of developments under way designed to assure even greater achievements in optical science in the future.

Bausch & Lomb Optical Co., Rochester, N. Y.

Ultraviolet and Visible Spectrophotometers—An inclusive 28-page catalog of Beckman ultraviolet and visible spectrophotometers—picturing all sample cells and other accessories—has just been released by Beckman Instruments, Inc. The two-color brochure, available on request, contains detailed descriptions and illustrations of the Model B and DU Spectrophotometers—precision instruments which measure and identify substances by passing light through them. Such well-known auxiliary units as the Flame, Reflectance, and Fluorescence attachments also are described. These multiply the analytical uses of spectrophotometry without requiring a heavy outlay for new basic instruments. The catalog features an extensive section treating the complete line of Beckman spectrophotometer cells, interchangeable sample compartments, and cell adapters. A composite price list-index is also furnished.

Bulletin 303, Beckman Instruments, Inc., South Pasadena 1, Calif.

Piezotronics—An informative 24-page brochure describing Piezotronics, its many functions, and its broad application, has been prepared by Brush Electronics Co. Modern Piezotronic systems enable manufacturers of dictating equipment and hearing aids to streamline their products. They help the Navy detect submarines, and inspectors detect flaws in materials. They provide a "memory" for computing machines, and a power source for users of ultrasonics. Supplementing the brochure is the 32-page "Piezotronic Technical Data." This reference compares general properties of piezo-electric materials, describes their basic behavior, lists electronic circuit applications and electronic circuit considerations, and gives basic electrical mechanical and electro-mechanical properties and equivalent circuit data.

Brush Electronics Co., Sales Promotion Section 64G, 3405 Perkins Ave., Cleveland 14, Ohio.

General Catalog—Just available from Consolidated Engineering Corp. is an eight-page catalog listing the following instruments. Analytical Mass Spectrometer, Isotope Radio Mass Spectrometer, Dual-Purpose Mass Spectrometer, Leak Detector, Titrilog, Micromanometer, Electrical Computer, Spectro-Sadic. The issue also features an article dealing with "The Mass Spectrometer Principle" and lists other analytical instruments.

Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 15, Calif.

General Laboratory Apparatus—A new issue of the "Eberbach Announcer" is now available. Published by Eberbach & Son Co., this issue lists Hollow Spindle Stirrers, Furnaces for high and low temperatures,

(*Continued on p. 80*)

TEST CABINET *for Salt Fog or Humidity Corrosion Tests*

FOR SALT FOG TESTS.... Meets the latest specifications of government and military authorities.

FOR HUMIDITY TESTS.... 95% to 100% relative humidity at room temperature to 125° F., temperature thermostatically controlled.

FEATURES

- Lucite nozzle
- Built-in heaters
- Fully insulated
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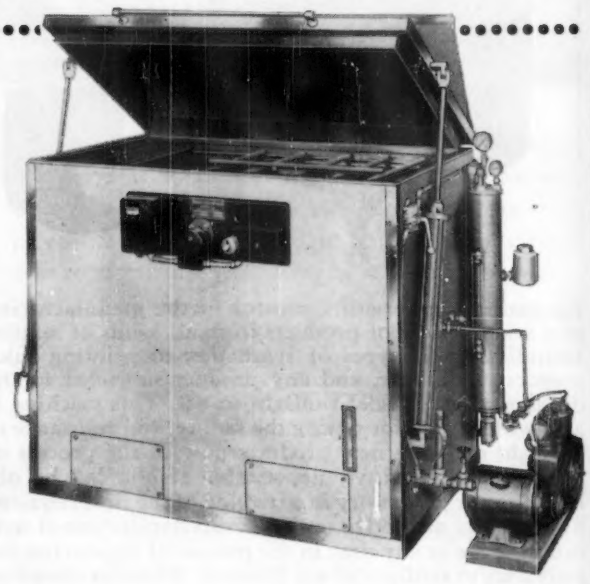
- Air-operated cover lifter (extra)



Standard No. 1 INDUSTRIAL Salt Fog and Humidity Test Cabinet with air-compressor unit and air-operated cover lifter. Larger sizes are engineered to requirements.

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• *VENTED TO PREVENT DRIPPING*
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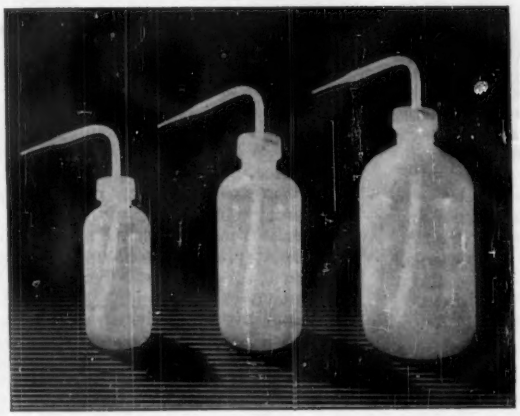

9823-E.

Washing Bottles, Squeeze Type, Polyethylene. Of chemically resistant pure polyethylene, flexible, tough, lightweight and practically unbreakable. Squeezing produces a steady, controllable stream or a few drops, as desired, with delivery stopped instantly when pressure is released.

This formulation is inert to distilled water, buffered, acidic or alkaline wash solutions and is not significantly attacked by corrosive solutions such as concentrated Hydrogen Peroxide, but is not recommended for use above 70°C or for volatile organic solvents.

Both screw cap and delivery tube are of polyethylene. Delivery tube has carefully formed tip and screw cap has a small vent to prevent dripping caused by overpressure resulting from rise in room temperature.

9823-E.	**Washing Bottles, Squeeze Type, Polyethylene,** as above described, complete with vented screw cap and delivery tube. Capacity, ounces	4	8	16
	Diameter of bottle, inches	1-7/8	2-1/4	3
	Each	.76	89	1.05
	Per dozen	8.19	9.60	11.32

9823-F.	**Fittings,** only, of polyethylene, consisting of vented screw cap and bent delivery tube. For conversion of stock polyethylene bottles into Washing Bottles. To fit Bottle, oz	4	8 or 16
	Cap size No.	24	28
	Each	.52	.52
	Per dozen	5.60	5.60

10% discount from "dozen" price in assortments of 144 or more.

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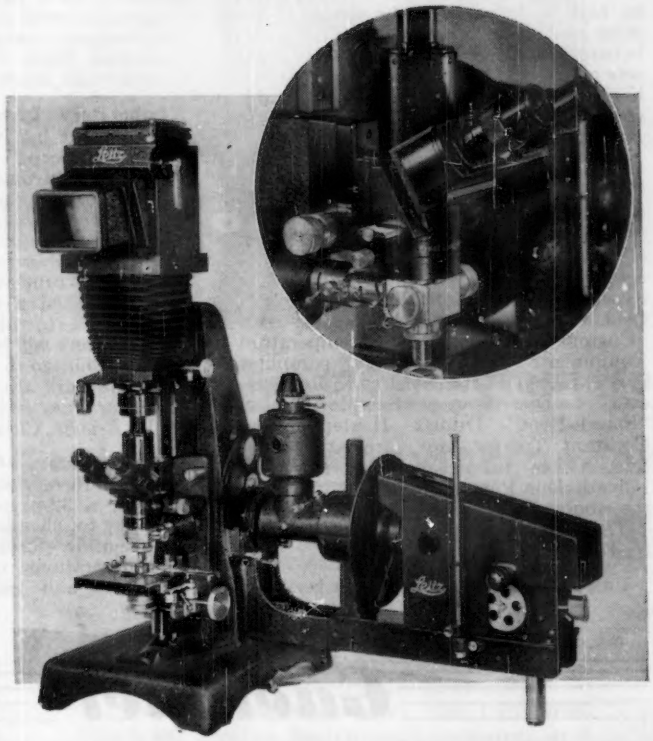

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(*Continued from p. 78*)

Laboratory Glassware Washers, Micropipette, Portable Specimen Polishers, David Pulverizer, Waring Blendor, and many other items for the laboratory.

Eberbach & Son Co., Ann Arbor, Mich.

Paint Panel Rack—In *Bulletin No. 130* Gardner Laboratory, Inc. announces the availability of "Steel Rack for Drying Paint Panels." The *Bulletin* lists the two sizes available, one being 36 in. long by 34 in. high by 4 in. wide, the second of the same length and height, but 5 in. in width between bars. Both size racks have eight sets of spacer bars for holding panels in a horizontal position. Racks have suitable space to hold as many as 96 3-in. width metal panels.

Gardner Laboratory, Inc., Bethesda 14 Md.

Laboratory Apparatus—A recent issue of "Labitems" is now available. Published by The Emil Greiner Co., this issue, indicated as Vol. 3, No. 1, contains newly listed items for laboratory use. Of particular interest is an article dealing with "Custom-Built Constant Temperature Equipment." This six-page pamphlet lists a Serval Portable Electric Refrigerette, a Dry Storage Sample Cooler, "Speedi-Heet" Duplex Heaters, New Constant Temperature Circulating System, Glass Immersion Heaters, New Polyethylene Pumps, and other items for the laboratory.

The Emil Greiner Co., New York 13, N. Y.

Unit Instruments—Two recent issues of "The General Radio Experimenter" featured new unit instruments. Both are part of the set of building-block instruments which form the General Radio Co. unit line. One issue lists Type 1215-A Unit Oscillator, covering a frequency range of 50 to 250 mc over a single continuous range. Frequency is read directly from a 6-in. dial with a calibrated slow-motion drive. The other booklet lists Type 1212-A Unit Null Detector, designed primarily as a balance indicator for ac bridges, is useful generally as a sensitive, wide-frequency-range voltage indicator.

General Radio Co., 275 Mass. Ave., Cambridge 39, Mass.

Laboratory Instruments—Catalog M, just released by Nuclear Instrument & Chemical Corp., includes many new laboratory instruments—including a new sample changer, new medical counting system, new personnel monitoring systems, and other new equipment for detection and measurement of radioactivity. Nuclear Instrument and Chemical Corp. has established a new trade name and trade mark to identify the company. This company will henceforth be known as Nuclear-Chicago to their customers, and a new trade mark will contain that phrase.

Nuclear Instrument & Chemical Corp., 229 W. Erie St., Chicago, Ill.

Supplementary Catalog—The Spring issue No. 15 of *Scientific Apparatus and Methods*, a 32-page publication, is now available to chemical scientists, buyers, and scientific storekeepers. Descriptions and illustrations of new oscillometric accessories and gas analysis apparatus are shown, in addition to specifications on micro projection balances, polyethylene bottles, automatic micro combustion apparatus, chromatographic separation apparatus, power supplies, Sargent's bubbling pipets, cloud and pour test apparatus, Sargent sublimation apparatus, and others are shown.

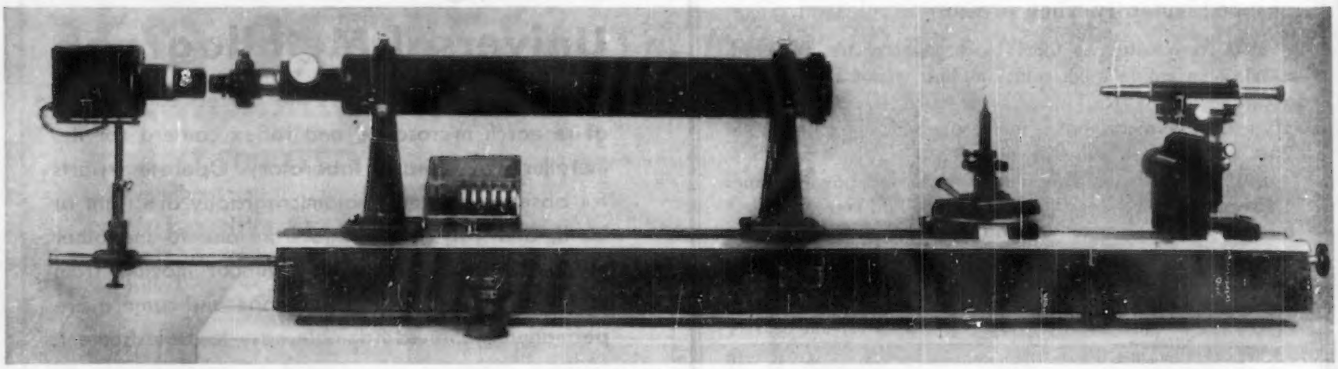
E. H. Sargent & Co., Chicago, Ill.

News of Commercial Testing and Research Laboratories

Electrical Testing Laboratories Inc., New York, N. Y.—Announcement was recently made of several changes in officers at Electrical Testing Laboratories, Inc., according to Norman D. Macdonald, Vice-President. F. Malcolm Farmer has retired as President after nearly 50 years of service. He continues on the Board of Directors, of which he has been elected Honorary Chairman. William F. Little, formerly Vice-President and engineer of photometry, succeeds Farmer as President. Leonard J. Lewinson has been named Executive Vice-President, vacating his previous responsibility as Manager of Special Lamp Services. Norman D. Macdonald, at one time Assistant to the President, and in recent years in Charge of Certification Services, Advertising and Personnel, becomes Vice-President. Herman C. Koenig has been added to the Board of Directors.

(*Continued on p. 82*)

Gaertner



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Standard equipment includes a heavy lathe bed type bench 167 cm long, a collimator with targets, filter, light source, and objective lens of 80 mm aperture and 915 mm focal length, a nodal slide carriage, and a microscope with fine motion control vertically, horizontally, and axially.

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ALSO AVAILABLE

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Model 7609C

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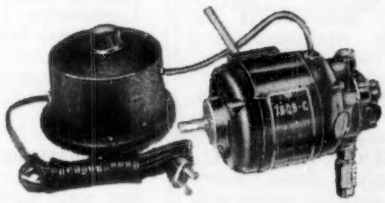

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- Table-top speed control rheostat.
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- 5/16″ true running chuck.
- Stainless steel mounting rod.
- Can be used with any laboratory support.
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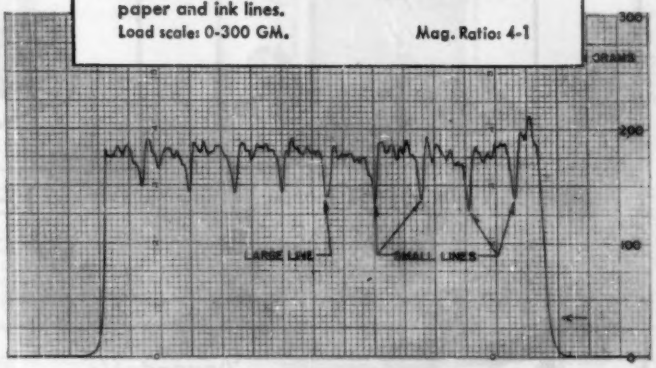

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(*Continued from p. 80*)

Hatch Textile Research, Inc., New York, N. Y.—May 1, 1953, marks the 27th Anniversary of Hatch Textile Research, Inc., a textile testing laboratory specializing in the analyses of fabrics and tests for serviceability since 1926. Administrative officers of the firm are Herbert H. Hatch, President, and J. W. Sheppard, Vice-President.

Foster D. Snell, Inc., New York, N. Y.—The Foster D. Snell organization announces their newest service, the Chemical Market Report (CMR) File Summary available to market researchers everywhere. This File Summary is compiled from Snell's monthly chemical industry abstract service, *The Chemical Market Report*, published since February, 1950. Their Report includes information on who-said-what-about-what-chemical, chemical company, or chemical consuming industry, in the hundreds of periodicals that publish news of a marketing nature about this industry. In the CMR File Summary, the Snell organization will review their own files and break their information down so that those interested may obtain a complete set of published news and information on any particular chemical, or specific industry such as soap, wax, or petroleum.

Instrument Company News

Bausch & Lomb Optical Co., Rochester, N. Y.—Lee C. Becker has been named manager of laboratory operations in Bausch & Lomb Optical Co.'s 155 branches throughout the U. S., vacating the post of assistant manager, according to Ben A. Ramaker, Ophthalmic Div. manager. He succeeds Roy O. Pennock, who was recently promoted to Vice-President and general manager of Bausch & Lomb Optical Co. Ltd. of Canada. In his new post Becker will assist in the development of the firm's ophthalmic sales program, and have charge of training branch managers in all phases of laboratory operations. He will also act as production consultant to independent distributors on methods, equipment, and training of laboratory technicians.

Beckman Instruments, South Pasadena, Calif.—Dr. Elden D. Haller has been appointed Eastern Sales Manager. Headquartered in a new Washington, D. C., office, Haller will supply a direct factory contact for Beckman district representatives and the scientific apparatus and recorder-controller firms which distribute Beckman products east of the Mississippi. James T. Luscombe has been named Sales Manager for Synchros Div. He will travel nationally to provide direct liaison between Synchro manufacturer and users.

Calresin Corp., Arcadia, Calif.—Henry Kveen, Executive Vice-President and General Manager of Calresin Corp., who have been the world's largest processors of compounded polyvinyl chloride hot melt materials, recently announced the purchase of Poly-Fiber, Inc., of Los Angeles, a subsidiary of Dumont, located at 4545 Brazil St., Los Angeles. Poly-Fiber, Inc., is one of the country's best equipped reinforced plastic molding and fabricating plants. This purchase is in line with Calresin's expansion plans in the plastic field covering hot melts, encapsulation of electronic parts, and reinforced plastic molding and fabricating.

Glass Engineering Laboratories, Los Angeles, Calif.—Announcement was recently made of the appointment of Robert H. Davis as manager of glass-apparatus and industrial glass-pipe sales in the Los Angeles branch office and plant of Glass Engineering Laboratories. In prior associations, Davis was field engineer for Spinco Service Co. and research chemist for the Atomic Energy project at the University of California and Monsanto Chemical Co.

Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.—Announcement has just been made of the opening of a new office at 3345 W. Hunting Park Ave., Philadelphia 32, Pa.

Nuclear Instrument & Chemical Corp., Chicago, Ill.—Announcement is made that Dr. George A. Fink and Dr. Murray E. Volk have joined the staff of Nuclear Instrument & Chemical Corp. as Associate Technologists. Dr. Fink, Associate Technologist in Research, received his Ph.D. in Physics from Columbia University, doing research on thermal energy neutrons. Dr. Volk, Associate Technologist in Chemistry, previously worked as a research fellow at the Research Institute of Temple University and Institute for Cancer Research.

TEMPERATURES to 3100°F.-3500°F.
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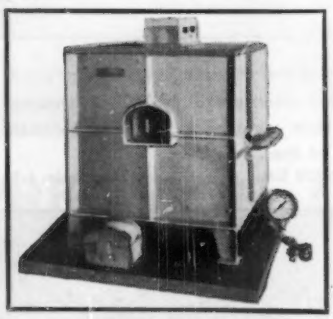
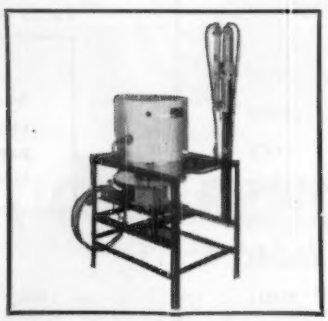
Kilns that feature close-control, wide temperature range and versatility. Extensively used in Quality Control—Research—Pilot Plant Firing—Ceramic Schools.



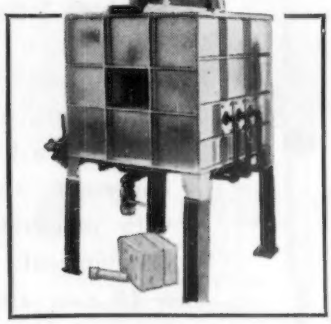
#2150

Setting Space—4½"x6½"x4". Temp. Range—1200°F. to 3100°F. Over-all Dimensions—Approx. 30"x30". Type—Gas-fired, semi-muffle; full muffle. Fuel—Propane, natural or city gas. Stack—none required.



#1800A

Setting Space—Cone plaque holds 22 cones. Temp. Range—Cone 40, as equipped. Over-all Dimensions—33"x 53". Type—Revolving (2 RPM). Floscope controlled. Fuel—Oxygen and acetylene.



#2320

Setting Space—12"x18"x9". Temp. Range—1200° F. to 3200° F. Over-all Dimensions—Approx. 4'x4'. Type—Gas-fired, single valve control. Fuel—Propane, natural or city gas. Stack—not necessary but desirable.

REMMEY

Dependable Refractories

#2350 (not shown)

Setting Space—24"x9"x7¼" high. Temperature Range to 3500°F.

RICHARD C. REMMEY SON CO., PHILADELPHIA 37, PENNA.